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## AUTOMOBILES FOR HIRE.

The development of the electric automobile hire system has been quite rapid, and is the cause of considerable activity, as our recent article showed, in regard to the new plant or stable of the Electric Vehicle Transportation Company in this city. At the present time of one electric make alone there are in use in the various cities plying for hire, the following number of vehicles, as nearly as can be ascertained: New York City, 360; Boston, 230; Newport, R. I., 60; Philadelphia, 55; Chicago, 115; Washington, 110; Atlantic City, N. J., 25; Mexico City, 30. There are also a considerable number of the same make in St. Louis, San Francisco and Detroit, as well as in Paris, London, Brussels and Berlin.

Such a showing is most laudable. It represents courageous investment and an infinite amount of hard work and ingenuity, and, of course, does not include any of the work done in introducing and operating private electric vehicles, of which there are already a great many also all over this country. The service given by all these vehicles this winter has been excellent, and the electrics have been able to show their qualities in more than one snowstorm or slippery frost. The expense of operation is still higher than one likes to see it, but will never be higher, tending, on the contrary, to diminish steadily with improvements, just as in every other branch of electrical development. It is true that the electric has not got the "radius" that will enable the owner to run it from New York to Buffalo, as, we are told, can be done with the steams and gasolines. But if any such trips are being made just now, either for fun or business, we have altogether missed the reports of them in the newspapers, although we have seen a Supreme Court decision to the effect that steam vehicles must all have an "avant guard" to warn the public they are coming while afar off. Such legislation is stupid and ought to be repealed if decisions can be given under it, but we are inclined to think that steam is going to have a pretty hard time of it, anyhow. There are so many practical objections to its use, despite its "radius," and perhaps because of it. Meantime, electric automobiles are quietly making headway.

## FASTER MAIL SERVICE.

It is remarkable that at this late day so little should be done to improve the speed of mail delivery. The chief opportunity under present conditions is at the terminals, for the railway trip between New York and Chicago and San Francisco can be cut but an hour or two, while in the cities the collection and transportation of mail is still relatively very slow, because subject to all the delays of the street traffic, weather, etc. Yet even where the pneumatic tube system has been introduced and used with fair success it has the amazing opposition of many men in Congress, who do not seem able to look forward to the time, sure to arrive, when all city mail will be dispatched by tube, probably with electric motive power as an economical substitute for compressed air, and cheaper. Dr. Norvin Green, of the Western Union Telegraph Company, long ago expressed his belief in such electric methods, and we see nothing that can long stand in their way.

It would indeed be interesting to know to what extent the telephone has interfered with letter writing, but there is no difficulty in computing the interference of the telegraph. It amounts to about one message, or letter, per head of the population. In other words,

if there were no telegraphs, people might write 80,000,000 more letters a year. This very statement is in itself a terrible condemnation of the undeveloped state of the telegraph. Why, after 60 years of growth, should it not carry hundreds of millions of the communications now sent by mail, with infinite gain in speed and general convenience, and the closer knitting together of the whole social fabric? We are unfortunately still in the primeval day of the Morse key. The telegraph companies still must earn about 30 cents a message. An operator to a circuit is still the standard. There is no patronage of any general system that will transmit a message faster than the operator can take it down. And the net result is that the telegraph is virually at a standstill, when it ought to be doing more business in a year than it has hitherto done in all its existence. Is it to be wondered at that telegraph stocks throughout an era of buoyant prosperity have either been stagnant or have declined?

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Only a few months ago Prof. Pupin, before the American Institute of Electrical Engineers, showed how to increase the efficiency of telephone land circuits. His beautiful invention—at first a pure mathematical creation—has been bought on generous terms and is already going into use. That is but one example of the manner in which telephony is being developed, and handsome as the reward of the inventor may have been, it is after all small compared with the impetus given to the art and to further invention of means which are already enabling the American people to exchange some 2,500,000,000 to 3,000,000,000 conversations a year. But why should not something analogous be done in the equally promising field of telegraphy? The neglect and contumely heaped on fast machine telegraphy is one of the deepest reproaches against telegraph management in this country. One of these days the companies may wake up to find the government with a system of its own chiefly for sending letters. To-day to send a special delivery letter costs 12 cents, at which rate, we are convinced, a big and profitable business could be built up between all our large cities in machine telegraph work. And these telegraph letters would not be purely of business origin. There is a very large volume of social correspondence that could be and would be expedited in the same manner. How long are we to wait before the telegraph is brought up to the level of these opportunities, cheapened, accelerated and made once again the profitable branch of electrical industry it once was?

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### ELECTROLYSIS IN THE DISTRICT OF COLUMBIA.

The article appearing in this issue on the subject of electrolysis in the neighborhood of Washington, D. C., is a local reflection of what is taking place generally in the neighborhood of many large cities. The electric railway is spreading rapidly and reaching out into the open country in many directions, which, until lately, only knew the hippo-mobile and the bicycle. With the increase in the strength and transmission radius of electric currents goes increased liability to electrolytic corrosion and destruction of iron gas pipes and water pipes. On the other hand, however, the increased capital expenditure and engineering facilities enable a greater degree of care and protection to be exercised so that with ordinary precautions and engineering skill there is no necessity to dread electrolytic action in the future. It is only when watchfulness is relaxed and careless management exists that this danger tends to become serious.

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It has been argued that if alternating currents could be satisfactorily employed in electric traction systems the dangers of electrolysis would entirely disappear, but this has been proved to be at least a partial fallacy. Feeble alternating currents are perhaps less likely to effect electrolytic destruction than feeble direct currents, but a strong surface density of alternating current is known to effect corrosion and this corrosion occurs at both electrodes, whereas, in the case of the direct current the electrolytic destruction only occurs at the surface of the buried anode or intermediate mass of iron acting locally as an anode on part of its surface. Consequently, it is not to the alternating current that engineers can look for complete immunity from metallic corrosion in cities. The conduit system with a completely insulated metallic circuit is undoubtedly a complete protection so long as the insulation of the circuit remains practically perfect, and even if, as in many cases, the insulation of one of the two conductors in a conduit is imperfect, the chance of stray currents effecting electrolytic damage must usually be limited. This solution of the difficulty is satisfactory in the case of large and populous cities where the heavy expenditure on the conduit system is warranted by the prospective heavy traffic. Such expenditure cannot, however, be made with a prospect of commercial returns either in small towns, or in the suburban districts of larger cities.

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The double-trolley system is less expensive than the conduit system, but the double-trolley overhead system is very cumbersome, and is more than twice as unsightly, darksome and mechanically dangerous as the single-trolley overhead system. It has been fairly successful in some cases and very troublesome in others. In spite of every precaution, the chance of a short-circuit between the two sides of the system is necessarily much greater in the double-trolley than in the single trolley system, and considering the danger of a heavy short-circuit, we doubt whether it can ever come into general favor. The practical remedy for electrolytic troubles lies, however, in the proper expenditure upon the ground-return circuit, whereby the local dangers of electrolysis can be so far minimized as to be practically obviated. Every city has the right to insist upon such means being adopted by the electric traction companies as shall protect the underground pipes of other corporate bodies, but they have no right to insist upon any unnecessary and superfluous expenditure in this direction. It is possible to be so virtuous as to incur criticism for sanity, and it is likewise possible to spend money in the morbid dread of electrolysis in a manner which intelligent persons fully appreciating the situation would contemplate with dismay.

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### UNITED STATES GOVERNMENT MAGNETIC OBSERVATIONS.

From the report of the superintendent of the United States Naval Observatory at Georgetown, near Washington, D. C., it would appear that the electric trolley roads are responsible for rendering useless the only two magnetic observatories which the United States possesses. While this is undoubtedly a matter for regret, yet it is something for which it would seem that no one can be held responsible, since the sites of these observatories were selected long before there seemed any possibility of magntic interference by traction currents. We know, however, that the advantage of rapid traction to the community considerably outweighs the importance of maintaining these particular magneto-graphic records. We also understand that two or three new magnetic observatories are either planned, or in actual course of erection, by the United States Coast and Geodetic Survey, which are sufficiently remote from large centers as to be beyond the probable range of the deadly trolley for at least many years to come.

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In the passage of the superintendent's report quoted, it would appear that considerations of gain have been allowed to outweigh considerations of scientific observation. The fact is, however, that such gains as the traction companies operating the offending system may be enabled to accumulate, are but a small fraction

of the total gain to the district employing the trolley, and of the community inhabiting the district. The comparison is, therefore, not between the revenue of a corporaion and the maintenance of a continuous photographic record of the magnetic elements, but actually between the transportation service to a community occupying a certain territory, and the maintenance of the record. On this point there can be, we believe, but one opinion. Since the expense to the traction company of stopping the magnetic disturbance would probably be extremely heavy, the reasonable procedure is to carry the automatically recording instruments farther afield. A proposition inimical to the transportation service of the Washington community comes with little grace from the United States Naval Observatory, in view of the insignificance of its services to the sciences it purports to represent. Though magnificently equipped and splendidly endowed by the Government, its lack of scientific standing among the observatories of the world is no less than a national humiliation—a situation, moreover, which will continue until the incubus of its present naval management is removed.

## SOME ELECTRICAL HYPOTHESES.

We do not desire to serve as self-appointed censors of electrical theories, nor do we wish to repress that free play of the scientific imagination which leads the mind through serious battles to new realms of knowledge. But we do earnestly wish that some great, clear-headed, conservative investigator like Kelvin or Rayleigh or Poincare, would take up and pass in careful review some of the curious ultra-atomic hypotheses of electrical action which are befogging the pathway of science with an intolerable cloud of indefiniteness. When new hypotheses really clear up phenomena which have been mysterious, they are welcome, but when they merely define the doubtful in terms of the unknown, they become of questionabl value as means of investigation. It is a little difficult to see how the doctrine of charged corpuscles, in itself innocuous and useful enough in explaining certain occult phenomena of the electrical discharge in gases, has risen to the prominence of an esoteric cult with such surprising rapidity, and it is high time that the fundamental matters to which it relates were subjected to searching investigation. We suspect that the basic facts on which the elements of the doctrine were cautiously formed by a few good investigators, have been forgotten by some of their less deliberate followers, and that the thesis-grinder has done the rest. The thesis-grinder is a singular creature well known in the higher academic circles. He plunges eagerly into the pursuit of any branch of science that promises a degree in the minimum length of time and follows it with feverish energy. In due season he is turned loose upon "original work," and the borderland of new and strange theories is his favorite browsing ground. We are far from wishing to cast aspersions upon the young man in science. Far from it—some of the very best work of the century has been done by men in the twenties, but the thesis-grinder is numerous, and he is not always a genius. If he can twist a new hypothesis to fit assorted facts, or the facts to fit the hypothesis, he rushes into print as soon as the thesis has served its chief end. To such we would commend the prudent and conscientious spirit of a certain young man named Newton, who was not willing to publish a theory which he had formulated regarding the attraction of bodies in general until the accumulated data of years had shown that it was correct.

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The experimental basis of these recent hypotheses may in some instances be sound enough, but while keeping our minds open in that agnostic spirit which holds final truth to be of greater moment than temporary complacency, we desire to call attention to certain objections to these tendencies of recent writers upon electrical science. The chief among these objections is the more or less metaphysical one that the corpuscular gentlemen do not vouchsafe an explanation that explains anything. To say that a molecule, atom, or corpuscle has an electric charge is a statement that may or may not be capable of complete experimental proof; but it certainly fails to explain the mechanism of electrical action in just the same sense that the old two-fluid theory of electricity failed. A molecular or atomic charge differs from a molar charge simply in magnitude, and the electric stresses between corpuscles, electrons or ions are just as difficult to explain as those larger stresses which they are put forward to elucidate. To say that chemical affinity is due to atomic charge is just as logical and satisfactory as to allege that all so-called electrification is due to the chemical stresses between the atoms; and so far as added knowledge goes one is equally benefited by either hypothesis, and would know quite as much if he were told that each atom was the houseboat of an active family of Maxwell's demons, paddled in the etheric stream by sculling with the valences; in fact, the conception of hurrying files of demons rushing growlers of positive and negative "juice" from house to house is rather attractive to the imagination, and as it expresses the facts as well as any other, is worthy of consideration by our friends the thesis-grinders. The fact is that any so-called explanation of scientific value must not be in terms of quantities just too small for experimental verification. Nor must it avoid one evident difficulty by involving two others to take its place. The whole business is suggestive of the epicycles of the old astronomers, and it is by no means impossible that it may prove to be of similar significance.

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Another very serious difficulty in the way of such investigations lies in the fact that most physical quantities are interlinked in a very intimate and intricate way. The mere atomic weight of an element connotes now a vast amount of more or less accurate detail as to its physical and chemical nature. Some say all this will appear in its true significance, but at present it is a source of some confusion. For if a theory, however far-fetched, be continued to fit neatly one particular set of relations, it inevitably will also within experimental errors automatically fit a considerable variety of other relations, so that the theory at once assumes an apparent importance perhaps never intended by its authors. Even mathematical investigations are not altogether safe from similar sources of error. One never can get out of his equations fundamental truth when his original assumptions are erroneous, but unfortunately he can obtain by perfectly rigorous processes results which are in form the same whether correctly based or not. Thus, the main electrical equations are the general equations of fluent quantities, and their development has no relation whatever to the physical entities of the flux. So far as the general theory goes it might be satisfied equally well by half a dozen hypotheses which all might be grossly incorrect, and it is only the most careful investigation in the light of experiment that can discriminate between them. The general theory of light was pretty well developed a century before the idea of streaming corpuscles completely disappeared, and up to a certain point this emission theory fitted the facts as well as any other. So it behooves us to be a bit cautious in accepting general conclusions merely because they are in accordance with certain facts. The law of inverse squares fits the conditions of radiation from a point, but we are not justified in saying that brickbats are being radiated because certain assumptions as to their weight and number would harmonize the energy received with that much-abused law. There is no subject that needs investigation more than the nature of electrical energy, and every new fact is a possible clue to the mystery. But it needs rare judgment to interpret the facts correctly, and we may perhaps be forgiven for saying that just now the interpreter is badly needed.

## Prof. Elihu Thomson on Electricity.

An admirable series of articles by leading authorities is now being published in the New York *Sun* on the various advances and developments of the nineteenth century in the whole round of human thought and endeavor. The eighth paper in the series is by Prof. Elihu Thomson on Electricity, occupying nearly 12 columns of the issue of Feb. 10, and covering the subject broadly. Each branch of the art receives attention, and is discussed in the clear, sane, attractive manner long since made familiar in all that Prof. Thomson says and does. Facts that are well known are grouped with skill and made fresh again, so that even those who have studied the subject can enjoy with the public this review of the "Electrical Century," although Prof. Thomson notes that only in its latter half can real utilization of electricity be said to have been effected.

As to electrical theory, we may quote Prof. Thomson as follows: "Has science any answer to make to the question, What is electricity? We think not, nor has it any answer to make to the question, What is energy? The most that science can possibly expect to do is to extend our horizon and permit us to acquire a deeper knowledge of the intimate relations of things. We speak of the ether as the electrical medium, and we acquire more and more knowledge of its properties and actions as the years go by. Facts are gradually being accumulated by workers in all departments of science, and there must follow generalizations which will bring into harmony the present discordancies where they appear. It will probably be found that the electrical properties of the ether are the fundamental ones on which the universe is built and that the properties of matter which we speak of as mass, weight, inertia, cohesion and elasticity, etc., are dependent upon or have their origin in the ether properties. Perhaps, just as light and radiant heat have been shown to be electrical vibrations, gravitation and the other properties may follow. True it is that electrical laws are most simple, most definite. Electrical measurements can be made with the utmost accuracy and delicacy. Indications these are of its fundamental and universal character.

"In order to account for the passage of light, radiant heat, magnetism and other forces through space, science has need of what is called the ether, a medium filling all space and propagating waves of heat and light, as well as magnetic disturbances and gravitation. The sun radiates to the earth luminous waves and heat waves. Moreover, it has been shown that whenever there is a great cyclonic storm upon the sun, the earth sympathizes or receives influences which disturb the compass needle. There is reason to believe that the 11-year sun spot periods find their expression upon the earth in the greater frequency of displays of aurora borealis, magnetic storms and even thunderstorms following the more active storm period of the sun, when the sun spots are most numerous.

"What, then, is the nature of this ether of space? To this question no complete answer can as yet be given, except to say that it is the electro-magnetic medium. * * * The renewed study of effects of electric discharge in vacuum tubes has already, in the work of such investigators as Lenard, J. J. Thomson and others, apparently carried the sub-division of matter far beyond the time-honored chemical atom, and has gone far toward showing the essential unity of all the chemical elements. It is as unlikely that the mystery of the material universe will ever be completely solved as it is that we can gain an adequate conception of infinite space or time. But we can at least extend the range of our mental vision of the processes of nature as we do our real vision into space depths by the telescope and the spectroscope. There can now be no question that electric conditions and actions are more fundamental than many hitherto so regarded.

"The nineteenth century closes with many important problems in electrical science as yet unsolved. What great or far-reaching discoveries are yet in store, who can tell? What valuable practical developments are to come, who can predict? The electrical progress has been great—very great—but after all only a part of that grander advance in so many other fields. The hands of man are strengthened by the control of mighty forces. His electric lines traverse the mountain passes as well as the plains. His electric railway scales the Jungfrau. But he still spends his best effort, and has always done so, in the construction and equipment of his engines of destruction, and now exhausts the mines of the world of valuable metals for ships of war, whose ultimate goal is the bottom of the sea. In this also electricity is made to play an increasingly important part. It trains the guns, loads them, fires them. It works the signals and searchlights. It ventilates the ship, blows the fires and lights the dark spaces. Perhaps all this is necessary now, and if so, well. But if a fraction of the vast expenditure entailed were turned to the encouragement of advance in the arts and employments of peace in the coming century, can it be doubted that, at the close, the nineteenth century might come to be regarded, in spite of its achievements, as a rather wasteful, semi-barbarous transition period?"

## The Institute Nominations.

The nomination blanks whereby the American Institute of Electrical Engineers invites its members to select candidates for the annual election of officers have just been issued, and this has at once stimulated interest in the choice of a president to succeed Mr. Hering, who has positively declined to stand for re-election. Owing to the fact that so far only a dozen members out of some twelve to fourteen hundred have reached the chair in the 17 years of Institute life, there is an abundance of excellent presidential timber, and several well-known men are already mentioned by their friends and supporters. The list includes the names of C. P. Steinmetz, Prof. M. I. Pupin, C. S. Bradley, C. F. Scott, William Stanley, C. O. Mailloux and L. B. Stillwell, all of whom stand high in the esteem of their professional brethren, and would serve most creditably. It would hardly be fair, however, to say that the lists were closed.

## Control of Enclosed Arc Patents.

It is understood, and the fact is officially confirmed this week, that the General Electric Company has secured control of the enclosed arc patents of the Marks Enclosed Arc Light Company. For some time past the General Electric Company had fought these patents, and had presented a very complete case for the defence, the litigation being in this respect one of the most interesting and important of recent years, in view of the universal vogue and popularity now enjoyed by arcs of the enclosed type. It would appear, however, that the General Electric Company, after the taking of the evidence, decided that the Marks patent had validity and value; and not caring to become merely a licensee, has now virtually absorbed the Marks Company, and abandoned its defence. The price paid is not known, but is said to reach in the aggregate several hundred thousand dollars and to be quite satisfactory to all directly concerned. The General Electric Company has already appointed new officers to represent its interests in the Marks Company, in whose name of course litigation against alleged infringers will be pushed. There are several enclosed arc manufacturers in the field, some of whom hold licenses under the Marks patents. The others are fighting the patents or disregard them as not covering the type of lamps they make. The old licenses are not affected by the changed conditions, but continue. It is reported that suit has been commenced in this city against a manufacturer not licensed who is putting in some enclosed arcs in a large dry goods store.

## The Automobile Club of America.

The club announces that the formal opening of its new clubrooms, 753 Fifth Avenue, New York City, will take place on Saturday, Feb. 16. Each member may be accompanied by one guest.

The Board of Governors has issued and called special attention to the following, asking that all members will respect such regulations:

RESOLVED, That driving automobiles by members of this club at an excessive rate of speed on the public highways in disregard of the comfort and safety of other users of the common roads, be and the same is hereby strongly disapproved by this club, as an injury to the sport and to a great industry; and that when members driving their automobiles meet the driver of a horse or horses which shall be restive or frightened shall, on request or signal from such driver, in all cases stop and use every effort and precaution to avoid the possibility of accident.

RESOLVED, further, That any member of this club who shall be found, after a fair hearing, to be guilty of driving at said dangerous and excessive speed on the public highways, and who shall have disregarded the comfort and safety of other users of the same by failure to stop when requested by the driver of frightened horse or horses, or who has been guilty of such conduct in the use of an automobile on the highways as shall tend to bring odium and reproach on this organization shall be duly warned and suspended, and upon repetition of such offence shall be expelled from this club.

## The New Middletown Drawbridge.

BY H. G. TYRRELL.

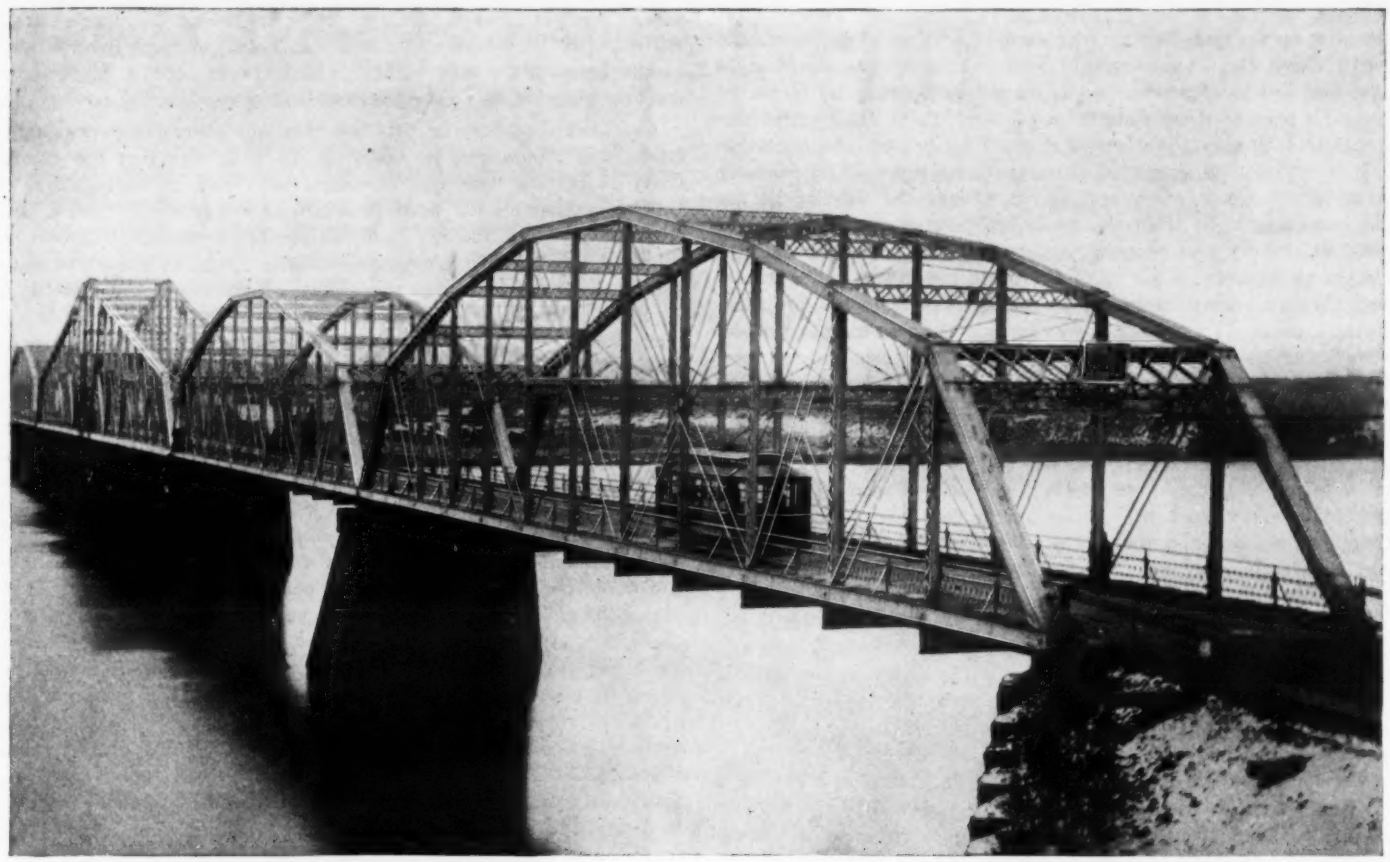
THE new highway bridge across the Connecticut River at Middletown, Conn., is 1300 ft. long, with a 26-ft. roadway, and provision for two 6-ft. sidewalks. Beside the street traffic it carries a line of electric railway, connecting Middletown with Portland. It consists of two fixed spans, 200 ft.; two of 225 ft., and a draw span of 450 ft. Up to the time of building the bridge in 1896 communication between the two towns had been kept up by means of ferries. The amount of travel seemed to warrant the construction of a bridge, so that the Middletown & Portland Bridge Company was formed to build and maintain a toll bridge. The location selected was about on the line of ferry, running from the foot of Ferry Street, Portland, to a point on Bridge Street, Middletown, about one-sixth of a mile above the railroad depot. It is 850 ft. up stream from the railroad bridge and 300 ft. below the end of Willow Island. The position of the island, with the channel on the west side, required the draw span to be about in the center of the river, thus making a symmetrical arrangement for the span. The Government required two clear waterways of 200 ft. each, which fixed the length of draw at 450 ft. This is believed to be the longest highway drawbridge in the world. The comparison table given below does not include a number of long-span railroad draw bridges that have a highway attached:

| | | | |
|---|---|---|---|
| Middletown Bridge | . . . . | 450 ft. | long. |
| Macomb's Dam | " . . . . | 412 " | " |
| Third Avenue | " . . . . | 300 " | " |
| Harlem Canal | " . . . . | 270 " | " |
| Cleveland | " . . . . | 279 " | " in two spans. |
| Charlestown | " . . . . | 240 " | " |

Notwithstanding its being 30 miles from the sea, there is a tide of 2½ ft., and the highest known water mark is 25 ft. above low water. The floor of the bridge was placed 6 ft. above the last elevation, making the distance from floor to low water 31 ft. At low tide the depth of water in the channel is 16 ft.

The width of bridge selected is that required for two lines of carriage travel, and one line of electric cars. This requires 26 ft. center to center of trusses. Provision is made on the floor beams for connecting sidewalk brackets in the future. The bridge floor is designed to carry a live load of 100 lbs. per square ft., 14-ton electric cars or a 10-ton wagon. The trusses are proportioned for a live load per foot of bridge of 1500 lbs. for chords and 2000 lbs. for web. The material used was iron for eye bars and lateral rods, and the rest excepting machinery is medium steel.

The turntable is entirely rim bearing. Eight loading beams transfer the weight to 16 points on the drum, which is 4 ft. deep, and 31 ft. diameter. This stands on 64 cast steel wheels 8 by 16 in., which run between cast steel beveled treads 2 in. thick at centre. The lower tread rests on wrought steel plates bolted to the masonry. This arrangement of turntable makes a simple construction, and is believed to be as effective for a highway draw, as some of the more elaborate combinations of rim and center bearing turntables, which depend on their adjustment for an even distribution of load. The drum and wheels are secured in place to a center casting by means of the usual radial braces and spider frame. This center casting is set down 6 in. into the stone pier, and secured to it by means of 8 bolts 1½ in. diameter and 6 ft. long, built solid into the pier. This casting has a hollow center for the passage of wires up to the bridge.



NEW ELECTRIC DRAWBRIDGE OVER CONNECTICUT RIVER.

The draw is operated by three 25-hp electric motors of the railway type, one for turning and the others for blocking up the ends. Besides these there is a fourth motor, and a duplicate set of turning machinery, all in place, which can be used in case of unbalanced wind pressure, or a break in the other machinery. Those two sets can be worked independently, or together at the will of the operator. Power is taken from the Middletown street wires, and a cable is laid on the river bottom, and brought up on the center pier. This passes in a groove under the wheel track and up through the center casting. The operating house stands on an overhead platform in the center tower. It has large windows on four sides, and an overhanging sunshade cave. The walls and floor are double thick, and it is provided with electric heat for cold weather. The platform is reached by means of a ladder from the bridge floor. It was originally intended that the closing of the gates should be done by the operator in the tower, and, in fact, the author of this article made a complete design for electrically worked steel safety gates. While these would cost $950 for the two gates, they would do away with the services of two gate operators. But on account of an accident

to the substructure involving extra expense the steel gates and some other machinery were omitted.

This last was an arrangment for closing the space between the rail ends, where the draw and fixed span join. In cold weather this opening is liable to be two inches or more. As this would cause a serious jar to cars and possibly a derailment, the author had designed machinery to close this space, while the toggles were tightening. There is also a lifting steel apron plate, to cover the curved openings in the floor at the end of draw, to lift up before the bridge is opened. Instead of the moving rail, an ordinary split rail is used that can be adjusted occasionally with the changing seasons, and instead of the safety gates a pair of temporary wood ones are now in use.

As already stated, the blocking up of the ends is done by two separate motors at the ends of the draw, placed under the floor. It is not infrequent to bring power from the center by means of a shaft, but the writer's experience shows that for long draw spans, this method is not satisfactory, as too much power is lost by friction in the boxes. The calculated deflection of the ends was 3¾ in., and after the bridge was completed and levels taken the actual deflection was found to be 3⅞ in.

Blocking up the ends is done by means of a pair of toggles at each corner. These are drawn together by two bronze nuts working on a right and left-hand screw, that is turned by bevel gears from the motor. To prevent these nuts from jambing, there are electric signals that tell the operator when to shut off his power. As a general rule, it is intended to simply block the ends up tight. This requires but very little power. But as there is always the liability of the blocks becoming tight from change of temperature or other causes, the end machinery was proportioned to lift 50 tons at each corner 1½ in. in 10 seconds. This required 10 hp, but it was thought best to use the same kind of motor as at the turntable giving interchangeable parts. To provide for expansion the end toggles rest on cast steel rockers of 17½ in. radius, which in turn bear on cast iron pier plates, blocked up to the right elevation with shims. The floor of the fixed span and draw were made to level up by notching the joist.

The latch is an extra heavy swinging gravity latch, to which is attached a line of No. 10 wire passing over pulleys to the center and connected by means of bell cranks with the operator's house.

To open by electric power takes 30 seconds, and the power required to overcome an unbalanced wind pressure of 5 lbs. on one-half of the bridge is 30 hp. Ordinarily, however, in calm weather 5 hp is sufficient to turn. It was necessary to use about four times the amount of resistance, ordinarily used on street-car work with the same motors. The reason for this is evident when the relative weight of bridge and car is considered. Both the center and end sets of machinery are provided with clutches, which can be thrown out of gear, and the operation performed by hand power. Working on 10-ft. levers the bridge is turned by four men in eight minutes. There is a friction brake applied to a drum on the highest speed turning shaft. This and the other turning machinery, including the motor, are placed on the outside of the drum beneath the floor in a machinery frame that can be sheathed in and protected from snow and ice. The whole bridge is well lighted with incandescent lamps, and has also the usual signal lights required by the Government.

## Electric Vehicles in Berlin.

United States Consul Hughes, at Coburg, states that Dr. M. Kallmann's report on the competition of electrically propelled vehicles in Berlin is highly instructive. The battery taking the first honors weighed only 121 pounds per kilowatt hour, while the heaviest weighed 286 pounds per kilowatt hour. The mean weight of the thirteen vehicles taking part in the competition was 165 pounds. Upon the assumption of a yearly total mileage of 9500 miles, he calculates the annual maintenance cost of a battery at only 48d., or, say, a cent per mile. The smallest consumption of energy per ton mile at the mean speed amounted to 91 watt hours for a passenger car, a far better performance than previous records are able to show. At the highest speed, the consumption increased to 135 watt hours. However, in the majority of cases, the demand did not vary greatly with the speed, which leads to the conclusion that, in order to obtain the greatest commercial economy of energy, the electrically propelled car should be driven at the highest speed consistent with public safety. By the high speed, the consumption of energy per car mile is not considerably increased, while the number of passengers which may be transported in a given time naturally increases with the speed.

## The Development of the Nernst Principle.

BY A. E. FAY, M. S.

IT seems that the earliest experiment having any bearing upon the recent invention of Prof. Nernst was made by one "Mr. Lane," who observed that "when electric shocks passed over the surface of a piece of marble—the part over which the fire had passed, was luminous and retained that appearance for some time," and after further experiments came to the conclusion that "all calcerous substances, whether animal or mineral, and especially when burnt into lime," as well as tiles and bricks, exhibited this property. This discovery was first announced by Priestley in his "History and Present State of Electricity," which was published in 1767. The earliest attempt to put this electrical limelight* to a practical use was made with some success by W. E. Staite in 1846, but, as far as the present subject is concerned, he added nothing to Lane's discovery.

Although this experiment was probably the first one relating to the production of light by electrically heating a refractory substance, the history of Prof. Nernst's idea really began with Sir Humphrey Davy's announcement that "the conducting power of metallic bodies varied with the temperature, and was lower in some inverse ratios as the temperature was higher" (Phil. Trans., 1821), for this was the first observation of the effect of heat on conducting power.

The next discovery in this line, and the one of supreme importance, was announced by Ohm in 1844; it was that the conductivity of certain salts was *increased* by a rise in temperature. In the 50's similar results were described in Poggendorff's and Liebig's Annalen by Kohlrausch, Buff, Nippoldt, Grotrian, Hittorf and others. The halogen compounds of silver, the sulphides of silver, copper, lead and iron, and the oxides of several metals were found to have this property, and Matthiessen discovered that the conductivity of carbon was increased by heat, though not to such an extent as in the case of some poorer conductors.

As is well known, the first to apply these discoveries to lighting was Jablochkoff, who, in describing his famous "candle" in 1877, says that in general, substances which are insulators when cold, become sensibly better conductors when heated to incandescence or even to redness, and afterward describes the use of a high-tension current from an induction coil, saying: "The body becomes a better conductor on all the points where the spark touches it, and at the end of several seconds the current passes easily where it could not pass before," the surface along the path of the spark becoming incandescent at the same time. Another means for heating the "colombin," or refractory material, to give it conductivity, which was proposed by him, was to connect the electrodes by a thin carbon strip or "igniter," on the surface of the "colombin." This being heated to incandescence by the current soon burned away, leaving a conducting surface on the refractory substance. He proposed plaster of paris, brickdust, glass, porcelain, lime, chalk, kaolin, magnesia, zirconia, etc., for the "colombin," which left little for others to do in the way of suggesting materials, but it may be of some interest to note a few applications of the principle which have been made.

Edison made one invention in this line in 1878, but went no further than to mix an iron or other metallic oxide, which would act as a conductor when heated, with iridium, for an incandescent filament, an idea that was followed by Hickley several years later, who mixed glass and a carbonized vegetable fibre. American inventors, however, were working in different and seemingly more important lines at this time, and the French Jablochkoff candle, "sun lamp," and the like, did not receive much of their attention. Three of the French inventions made between 1881 and 1884, however, deserve attention in this connection.

An electrical company patented a lamp in which a wedge-shaped piece of "magnesia, or other body, which is a non-conductor when cold and a conductor when heated," was employed to furnish the light. A platinum wire passed up one side and down the other, and was made of smaller cross section at the edge of the wedge, so as to heat the magnesia more at that point. The result was, as stated, that after the magnesia was once heated at the edge to incandescence, most of the current passed up the thicker portion of the wire on one side, then through the incandescent part of the magnesia and out through the thick portion of the wire on the other side.

In Tihon's lamp two carbons were placed in a refractory substance not quite parallel, with their points approaching so that the

*The first account of Capt. Drummond's lime light was published in the "Philosophic Transactions" of the Royal Society in 1826.

"colombin" would not waste away so rapidly as its conductivity increased with the rise in temperature.

Beck patented a lamp which, in the language of his claim, consisted of "a permanent electrode, a carbon electrode arranged to rest thereon, a plate of porcelain or other equivalent material arranged in contact with said electrodes, and means whereby, after the establishment of a current sufficient to develop the conducting power of said plate by heat, the said carbon electrode is maintained in contact with said plate, at a substantially constant distance from said permanent electrode."

One of the most remarkable of the old inventions, however, in view of recent developments, is contained in a British patent taken out in 1878 by W. S. Scott, an engineer, of Wolverhampton, England. He claimed a "mode of largely reducing the resistance of electro-calcic burner by employing a large metallic reflector," presumably surrounding the burner or filament, except on one side, and reflecting the rays back upon it to assist in heating it. The device is not clearly described nor explained in the patent.

In 1888, Rudolph Langhaus, an Austrian, rediscovered that the metallic oxides were conductors at high voltages, and in 1896 several Swiss scholars found that a mixture of graphite coal tar and an infusible metallic oxide was suitable for use on 100-volt circuits.

## Electrical Illuminations in Mexico.

A visit paid recently by President Diaz, of Mexico, to the city of Pueblo for the purpose of dedicating the French and Mexican Soldiers' Monument and other new buildings, afforded an opportunity for electrical illumination which was promptly availed of by the Pueblo Electric Light Company. This concern was one of the first fruits of the export trade in electrical apparatus, and has now been in existence 10 years or more. It is equipped with General Electric machinery; has 7500 incandescents and 250 arcs, and always has some American in charge of the electrical department.

Two features of the illumination are shown herewith. The fine arch was built by the company for itself, and rose to a height of 45 ft., with a width of 26 ft. It was lit up by no fewer than 700 lamps and 3 arcs. On one side were the letters, "P. D.," for Porfirio Diaz; and on the other, "Paz," or "peace." The other illustration shows the decorations of the Spanish colony in the Zaragoza Street. This beautiful piece was elaborately floral and contained 800 lamps. There were also 100 lamps in their Casino. Such displays are very unusual in Mexico, and hitherto have been seen by very few of the natives, so that they created a tremendous effect and gave unbounded pleasure to the crowds thronging the city.

All told, the company had about 3000 extra lamps on the new palace and arches, etc., which, added to the regular lighting and the illumination in the stores, transformed old Pueblo at night into a rarely beautiful spectacle. We are indebted to Mr. H. H. Wilson, superintendent and engineer of the Pueblo Electric Light Company, for this opportunity to note an interesting and tasteful electrical display in the sister Republic.

STREET ELECTRICAL ILLUMINATIONS IN PUEBLO, MEXICO.

## Electrolysis in the District of Columbia.

BY GRAHAME H. POWELL.

THE rapid extension of electric car lines in and about the District of Columbia, the majority of which have grounded returns, or, at best, inadequate metallic circuits, with the consequent dangers of electrolytic action to the gas and water mains of the city, as well as to the telegraph and telephone cables, has led to a recommendation on the part of the Commissioners of the District that Congress should provide more stringent penalties for failure on the part of the electric light and power companies to provide a proper metallic return for the powerful currents employed.

The recommendation of the Commissioners is embodied in an extensive report, giving the text of the legislation desired and which, it is hoped, will enable the District to compel the power companies to make adequate provision for the protection of the network of mains underlying the city of Washington.

Serious attention was first attracted to the dangers of electrolytic corrosion in the early part of 1897, the period which marked the beginning of the extension of the trolley systems about Washington. In the spring of that year the telephone companies observed that their cables were charged electrically much higher than had previously been the case. An investigation resulted in the discovery that the lead-covered cables in the conduits of the company were carrying the return currents of a large part of the supply furnished the trolley roads by the Potomac Electric Light & Power Company. The telephone company sought to remove the danger to its lines by running a zero copper wire through its conduits and bonding the cables to it; but

this method was only successful after the copper wire had been connected with the negative pole of the power company's generator at the power house.

In the course of his report, the engineer officer who investigated the subject of electrolysis in the District, says that "with the large increase of late years in the use of electricity for lighting and power purposes, the damage resulting to underground metallic constructions from the use of ground or uninsulated returns has greatly increased, and the evils from such an incomplete system of distribution for electricity are beginning to be fully realized. In many cities the question of the prevention of electrolytic action on such constructions is being very seriously considered. With the absence of overhead trolley roads in the city of Washington, the question has been an unimportant one until recently. Conditions have, however, changed so markedly in the last two years that it should have immediate attention. So long as the trolley roads did not enter the city, and while each one had its independent small power plant, the return of the current to its point of generation was accomplished through the ground or otherwise without any material damage to gas and water mains, etc. Recently a large central power station has been established within the city limits from which nearly all the trolley roads in the District of Columbia, and some in Maryland and Virginia, obtain their power. This station also furnishes current for public and private lighting at various points within the District. Current so generated is constanty delivered to many points, some of which are a number of miles distant. In many instances this current has to find its way back to the station through the ground and such metallic constructions in it as offer the least resistance, no proper metallic return having been provided. Where a metallic return has been provided it is uninsulated, and only partially serves its purpose." The report then goes on to point out specific instances of damage resulting from these return currents.

One of the phases of the question is set forth in a report by Capt. C. H. Davis, United States Navy, superintendent of the Naval Observatory. Capt. Davis in the course of his report says that the observatory is situated on a spot selected by a commission appointed for the purpose. The site contains nearly 70 acres in the suburbs of the City of Washington and was purchased in 1882. The site chosen was one that was expected to remain free for all time from the disturbances due to the proximity of a city and the effects of traffic. As Capt. Davis says, the electric railway had not then been perfected, and no more desirable site could have been selected. The construction of the necessary buildings, the laying out and grading of the grounds, and the removal of the instruments from the old observatory extended over a period of ten years, and to-day the place where the astronomical observations and calculations are made by the officers of the government is one of the most picturesque about Washington.

Among the many delicate instruments installed in this supposedly out-of-the-way location are a number of magnetic instruments which are self-registering by means of photography. The impossibility of using these instruments under present conditions is the occasion of Capt. Davis's report. The magnetic instruments referred to were mounted in January, 1894. He says:

"There are two lines of electric railway passing on parallel lines in a northwesterly direction on either side of the observatory grounds, the Georgetown & Tenallytown Road, with branches which extend to distances of from 7 to 8 miles from the terminus in Georgetown, the main line passing within 1400 ft. of the magnetic observatory, being the nearest, to the west. The other road runs from Washington to Chevy Chase, passing the Observatory to the east at a distance of three-fourths of a mile.

"When the instruments were mounted it was immediately noticed that there was a disturbance of the vertical force trace during the hours when the cars were running on the Georgetown & Tenallytown road. This disturbance was not at first sufficiently serious to destroy the value of the observations. It was apparent in a widening and blurring of the line (trace), and the question was raised as to whether the disturbance was mechanical, and an experiment was undertaken to determine this, with a negative result. The disturbance remained about the same until the spring of 1897, when it gradually assumed larger proportions, and began to show itself also in the horizontal force and declination, the increase in disturbance being attendant upon a very heavy increase in the traffic of the road. It became evident that the effect of currents from the roads operated not only to blur the trace, but to increase the vertical force. * * *

"The disturbances so far noticed have been traced directly to the nearest road, the Georgetown & Tenallytown, but were traffic on this road to cease the observatory would still be within the radius of influence of the Washington & Chevy Chase road, three-fourths of a mile distant, the effects of which are obliterated in the preponderating influence of the closer road. * * *

"In addition to the disturbances which can be traced to the electric railway, there are during the night hours, at more or less regular times, small disturbances which are probably due to throwing off the current in arc light circuits in the city, these circuits having a grounded return wire.

"It thus appears that the use of powerful electric currents for commercial purposes has destroyed the usefulness of the only two magnetic observatories on the North American continent. That is, considerations of gain so far outweigh considerations of science and knowledge that the latter do not enter where questions of money prevail."

The report of Mr. Walter C. Allen, the inspector of electric lighting of the District, which accompanies the Commissioners' recommendation to Congress, contains a great deal of interesting reading and shows a careful and intelligent investigation of the subject of electrolysis.

Mr. Allen says: "This inspection of the trolley roads involved more than mere readings of the potential difference between water main and rail; it embraced a thorough examination of the feeding circuits, the size and efficiency of the return, and the general condition of the roadbeds. This ground was gone over quite thoroughly in the fall of 1895, and report made of the results. Since then several important changes have occurred to increase the danger to which the mains are exposed. The Potomac Electric Power Company, which was then just beginning to operate to any extent in the District, had its power plant in the station of the Georgetown & Tenallytown Railway Company, and confined its operations to furnishing current for a limited number of incandescent lamps, both public and private, on the alternating system, and to supplying current to the above-mentioned railroad and to the newly installed Washington & Great Falls Electric Railway. Since then it has, with commendable enterprise, extended its lines to all portions of the District, besides reaching railroads operating both in Maryland and Virginia exclusively, until now it is an important factor in the electrical engineering field. The new power house of the company, in Georgetown, contains the most modern machinery, well adapted to the service to which it is put. * * * In addition to the alternating system employed by this company, which is a complete metallic system and does not enter into the question involved in this report, it supplies current from its grounded railway generators to public arc lamps and to stationary motors, besides running several overhead trolley roads."

Mr. Allen concludes that the solution of the problem is quite simple, though legislation is necessary before the railroads can be compelled to adopt the remedy. He says the extension of the underground electric system such as is employed on the Metropolitan Railroad lines, a local corporation, is, of course, too expensive to put in operation; but its substitute, the double trolley, he believes, can be easily installed and successfully operated. Either this must be done or some other equally good metallic circuit system must be provided.

In a former report on this same subject, Mr. Allen calls attention to a case of electrolytic action. The water main was comparatively new, having been down only about 18 months, and showed no signs of damage; but the service pipe was badly corroded and was, in fact, leaking at one place where the current had eaten entirely through.

Capt. Davis, in a report written prior to the one already quoted, says:

"As these railways are now managed, it would probably be necessary to remove our magnetic instruments to a distance of at least two miles before the effects of local disturbances would cease to be felt. This would retire the observatory from the national capital, which, in view of the amount of money already spent here and the beauty and fitness of the site in all other respects, is not to be thought of. The only other alternative is to discontinue magnetic observations here. This would be a loss to science, because there are only two magnetic observatories on the continent of North America, the other one, situated at Toronto, being unfortunately in the same predicament as ourselves, owing to the close proximity of a trolley road; so that the accumulation of accurate magnetic observations, which are of incalculable value for the future solution of one of the great problems of nature, has practically ceased in North America."

The Senate committee has reported favorably on the proposed bill, the main provisions of which are as follows:

"That each and every street railway company in the District of Columbia using the overhead trolley system for the propulsion of its cars, or using any other electrical system employing an uninsulated, a grounded, or a rail-return or feeding circuit for the current, shall equip its lines with the double trolley system, or other equally good insulated metallic circuit system."

"That after the passage of this act it shall be unlawful for any person, company or corporation in the District of Columbia to furnish current for electric light, heat or power on a circuit or system, any portion of which is grounded or connected to any grounded construction, or which is not thoroughly insulated from the ground. It shall be unlawful for any person, company or corporation in the District of Columbia to use any dynamo, generator, motor or transforming device in connection with any lighting or heating apparatus for the production or utilization of electric current any pole or terminal of which is grounded or connected to the earth or any grounded construction."

A penalty of $25 a day is provided for each day's non-compliance with the provisions of the act.

## A Chemical Printing Paper.

BY JAMES ASHER.

MR. GREEN, of London, has recently invented a chemical paper which may be printed without ink, and without previous moistening or other preparation on the part of the printer. The chemicals are mixed with the paper pulp during manufacture. The paper can be made at as low cost as common paper, because only low-priced chemicals are necessary. The paper is white, and it is not affected in any other manner than by currents of electricity. It will last for any length of time. It gives a jet black, lasting impression, and requires neither drying nor other treatment after the printing has been effected. The printing machine is a common printing press from which the inking devices have been removed. The part which carries the paper is made of metal. Types and cuts of any design may be used.

Either a dynamo or a battery has one of its terminals electrically connected with the cylinder which bears the paper, while the other terminal is connected with the form. During the passage of the paper through the machine the current of electricity passes through the paper and causes electrolysis of the chemicals therein contained, leaving dense black stains having exactly the same form as the types. A current of 4 amperes at from 10 to 110 volts is sufficient in machines of the largest size. The power necessary to drive the machine is less than usual, because of the absence of inking machinery. The cost of the press is said to be about two-thirds that of the common press, and the cost of the electric current is only one-half the cost of ink. At Blackpool a rotary press printed at the rate of a hundred copies a minute and is claimed to be doing absolutely perfect work. Whether or not the blackening effect extends quite through the paper has not been stated. If extending quite through, it would practically prevent the use of the new method in printing newspapers or other sheets requiring words on both sides. On the other hand, if the blackening effect extends through the sheet, there may be a chance to secure the advantage of manifold printing by merely passing several superposed sheets through the machine at the same time. Currents of higher tension than usual would be necessary in manifold printing.

It seems to me that several other uses might be made of the new paper. It might be used instead of the troublesome moistened paper in automatic telegraphs which chemically record the messages. Even telegraphs which record with ink, such as Wheatstone's automatic, the Morse inkwriter, Meyer's autographic telegraph, the telautograph, and perhaps even the siphon recorder used on submarine cables could use the new paper with great advantage. 'In some of these the current which passes through the paper would not pass over the line, but a relay would bring a local current into action by means of which the required impressions would be recorded. Printing telegraphs such as the stock ticker, Hughes' printer and even the very rapid page printer, recently patented by Mr. Buckingham, might record their messages by electrolysis in Green's paper. Possibly it would be practicable to record the messages on several papers superposed, and so produce the desirable result of manifolding in all the telegraphs in which the paper could be used.

Manifolding on typewriters could also be done in a similar manner. A metallic cylinder, bearing the paper, would be necessary. It might even be advisable to use this paper on typewriters when printing single sheets in many large offices.

Again, a person could with a metallic pencil in an insulating holder perform the operation of writing single sheets or do manifold work. The electric wires would be connected with the top of the pencil and with a metal plate under the paper. It would be possible to considerably diminish the chances of forgery were a business man to use the chemical paper in his transactions, either with the typewriter or with the metallic pencil in the manner which I have just proposed.

## Steam Heating from Central Stations.

BY ALTON D. ADAMS.

STEAM may be distributed from central stations at either high or low pressure. For high-pressure distribution, or that from 20 to 100 lbs. by the gauge, the steam must usually be taken directly from the boilers where it is generated, but a reducing valve may be employed if desired to reduce the pressure in pipes below that of the boilers. In distribution at low pressures from 1 to 20 lbs. above that of the air, steam may be taken from high-pressure boilers through a reducing valve, from low-pressure boilers or from an exhaust tank for engines. In a station devoted exclusively to the distribution of steam the boilers would naturally be operated at the pressure required in the pipes. At stations that distribute both electric energy and steam, a high-pressure pipe system may be supplied directly from the boilers, or a low-pressure system from either the boilers, the exhaust steam tank, or both, according to the extent of the service and whether the engines are operated condensing.

The pressure at which steam is distributed will largely determine the uses to which it may be put. Steam at high pressure in the pipe system is suited to the production of power, by means of engines, and to all classes of cooking, laundry work and general warming, through suitable reducing valves. Low-pressure steam is available in the laundry, for some kinds of cooking and the heating of buildings. If steam is distributed simply for general warming purposes, there is little reason to deliver it to the pipes of consumers at more than 2 to 5 lbs. pressure, as this is usually enough to force it through the local heating system. The pressure necessary to force the required amount of steam through the pipes of a public distribution system is subject to much variation, depending on their design, but may readily be 5 or 10 lbs. in a low-pressure supply for heating buildings. As steam at low pressures is mostly used for general warming purposes, the demand for it is very small during four to six months of each year.

If distribution pipes are supplied with exhaust steam from engines, as is desirable at electric stations, whatever pressure is necessary in the exhaust tank acts as a back pressure in the engine cylinders. This back pressure reduces the power of the engines and lowers their efficiency. The power and efficiency of engines is also lowered by the lack of a partial vacuum that might be had if the exhaust steam were condensed. This vacuum may be 10 or 12 lbs. per square inch below atmospheric pressure. Engine power may be brought up to that possible with a condenser, by a suitable increase of the boiler pressure. If all of the exhaust steam can be used in the heating system, the drop in the efficiency of engines affects the efficiency of the combined equipment to a much smaller extent. This is evident from the fact that while the total heat of exhaust steam at atmospheric pressure is 966 heat units above that of water at 212 degs., the total heat of steam at 100.3 lbs. gauge is only 1177 units above water at 40 degs.

The distribution of steam through long pipes involves losses of two distinct kinds, a loss of pressure due to the friction of the pipes and a loss of heat from their surfaces. Both of these losses increase directly with the length of pipe through which steam is delivered. The loss of pressure increases with the square of the velocity at which steam flows through the pipe and with the friction of its surface. Heat loss by radiation and conduction also increases with the diameter and temperature of pipes, and with the radiating and conducting powers of their coverings. It will be noted from this that an increase in the diameter of pipe lowers the loss of pressure from friction, by allowing a smaller velocity of steam for a given rate of delivery. But the larger diameter and surface make the loss of heat by conduction and radiation greater. A result is that for a given rate of steam delivery, at a certain temperature, with a certain pipe covering and quality of interior surface, there is one size of pipe that involves a smaller total loss than any other. It is thus quite as possible to have a pipe too large as too small for the best economy. The combined

loss in pipes of friction and condensation should not exceed 20 per cent of the total energy in steam transmitted at their maximum rate, over distances up to one-half mile. The loss of pressure in pipes one-half mile in length need not usually exceed 10 lbs. at their highest rate of delivery.

In the early development of steam distribution from central stations, two pipes were laid to the premises of each consumer, one to deliver the steam and the other to return the water of condensation to the central station. As a gravity return is not practicable for the extensive system of a central station, pumps were used to return the condensed steam. It was found that the additional expense and complication necessary for return pipes was not warranted by the value of the condensation, and such pipes have been abandoned. As now laid, the distribution system of a central heating station contains but one set of pipes, where steam is used. Service pipes from the steam mains are each supplied with a regulating valve just outside or inside of the consumer's premises, in the case of high-pressure service, so as to insure a nearly constant pressure of the desired amount. Where the steam supply is at low pressure, as 5 or 10 lbs., the regulating valve is not necessary. The hot water from steam condensed within a building becomes the property of those who buy the steam and may be used for any purpose to which it is suited. In some cases this hot water is collected in heater coils over which a supply of fresh air from out of doors is passed and warmed for ventilation.

Since a first-class boiler plant with economizers may deliver as much as 80 per cent of the contained energy of coal to water and steam, this amount less the losses in distribution mains is available at the premises of consumers. If steam pipes are so proportioned and laid that their loss of heat amounts to one-fifth, or any other definite portion, of that latent in all of the steam entering them, during periods of maximum service, the average loss must be a much larger part of the total steam used. This increase of the average per cent of loss in pipes over that for maximum service is due to the fact that the average supply of steam for heating must be much less than the maximum, while the amount of loss in heat units is nearly constant, whatever the flow of steam. With a heat loss of 20 per cent from the pipes at the maximum flow of steam, the per cent of loss would rise to about 40 for one-half and 80 per cent of latent heat for one-quarter the maximum rate of steam delivery to pipes. Experience at central heating stations has shown that the consumption of steam is at a monthly maximum during December, January, February and March, this maximum being reduced by one-one-third for November and April, and about two-thirds for May and October. From all of the data at hand it seems fair to estimate the average per cent of loss of heat from distribution pipes for low-pressure steam at one-half greater than the per cent of loss at the maximum rate of delivery. A loss of 20 per cent of the latent heat of steam during the maximum rate of delivery thus implies a loss of 30 per cent for the average rate. To change 1 lb. of water at 40 degs. to steam at 10 lbs. gauge pressure requires 1147 heat units, and on condensation at atmospheric pressure, as is nearly the condition in the radiators of consumers, 966 heat units are given up. If .3 of the steam is condensed in distribution pipes, their efficiency as to the latent heat is $(966 \times .7) \div 1147 = 59$ per cent. If the water of condensation is cooled from 212 to 40 degs. at the premises of consumers, the efficiency of distribution is $(676 + 173) \div 1147 = 74$ per cent. With boilers of 80 per cent efficiency, the low-pressure steam system has an efficiency from the fuel to consumers of $80 \times .59 = 47$ per cent for latent steam heat and $80 \times .74 = 59$ per cent if the water of condensation is cooled to 40 degs. As the pressure of steam in distribution pipes goes up their temperature and the losses by radiation also increase. Steam at a pressure of 15.3 lbs. by the gauge has a temperature of 250 degs., while at 100.3 lbs. gauge its temperature is 338 degs. The rate at which heat is radiated from the distribution pipes varies directly with the difference between their temperature and that of the surrounding air or earth. If the temperature of the air or earth about pipes is taken at 40 degs. the pipes with steam at 15.3 lbs. are 210 degs. higher in temperature, while pipes with steam at 100.3 lbs. are 292 degs. higher in temperature. The pipes at the higher pressure may therefore be expected to show a heat loss 1.4 times as great as those at the lower pressure. The high average loss from pipes for steam distribution is due in large measure to the fact that the temperature of such pipes must remain nearly constant whatever the rate at which steam is passing through them.

As the demand for steam is very light during a large part of each day in cold weather, and decreases at all times of the day as the weather grows warmer, while the loss of heat from pipes remains nearly constant at all times, there are many periods when the steam condensed in the distribution pipes is larger in amount than that delivered to consumers. Where the exhaust steam at an electric station is to be utilized for general distribution, several factors beyond those involved in supply from a simple steam heating station have to be considered. One of the most important points relates to the distribution as to time during each day of the demand for heat and the supply of exhaust steam. The maximum demand for heat usually occurs between 6 a. m. and noon, but the greatest rates of supply of exhaust steam at electric stations take place between 4 and 10 p. m. If only exhaust steam is supplied to the distribution pipes, it is evident that either the excess of exhaust at times of heavy loads in electric stations must be stored for subsequent use, or else that it must be applied to some purpose other than heating. Even at 10.3 lbs. gauge pressure, 1 lb. of steam occupies 16 cubic feet. Allowing 36 lbs. of exhaust steam for each kw-hour of electric energy delivered at the station, the necessary tank space for exhaust at 10.3 lbs. pressure corresponding to this unit output is 576 cubic ft. To store one-half of the exhaust during two hours of a station operating at 500 kw, supplying 10,000 incandescent lamps, requires therefore a tank space of 288,000 cubic ft. This space would be provided by an exhaust tank 75.5 ft. in diameter and 65 ft. high. These figures are obviously so impracticable for application that their discussion is unnecessary. Since it is not desirable to attempt to store steam because of its great volume in proportion to weight, the maximum or morning demands of a heating system must be met with much less than the greatest rate of supply of exhaust steam, if none is taken directly from the boilers. Such a condition seriously limits the extent of heating systems from electric stations.

A solution of the difficulty, so far as it limits the extent of a heating systems, is found by taking steam from boilers through a reducing valve, to supply the distribution pipes at times when the demand for heat cannot be met with the available exhaust steam. This plan leaves open the question as to what shall be done with exhaust steam, in excess of the demands for the heating system, during periods of maximum loads at the electric station. Either or both of two methods may be followed in the use of exhaust steam beyond the amount that can be distributed in the heating system at any one time.

One plan is to operate a part of the engines condensing, during times of greatest loads at electric stations, and all of the engines non-condensing on the lighter loads. This practice involves condenser capacity for most or all of the engines, and their variation between condensing and non-condensing action at different times of day. Condensers are thus in use but a small part of the time and the changes in engine operation involve some extra attention, but the plan is much better than that on which any large amount of exhaust steam goes to waste.

Another plan is to use all excess of exhaust steam during periods of heavy loads at electric stations, to heat feed water for the boilers during the remainder of each day. The extent to which this method can be applied is evidently limited by the amount of heat that feed water for operation during an entire day can absorb from the exhaust steam. As is well known, the weight of exhaust steam rejected from engine cylinders is materially less than the weight of live steam entering them. This result is due to cylinder condensation, and an average value for the portion of the total steam consumption leaving cylinders as water may be taken at 20 per cent. On this basis the 36 lbs. of exhaust steam rejected by engine cylinders per kw-hour of output at electric stations, implies a consumption of 45 lbs. of feed water by boilers for each delivered unit of electrical energy. To heat 1 lb. of water from 40 to 212 degs. F. requires 173 heat units, but if the exhaust steam is only 80 per cent by weight of the steam entering the engine, 216 heat units must be supplied by each pound of exhaust steam to heat the 1.25 lbs. of feed water entering the boiler. At atmospheric pressure 1 lb. of steam contains 966 units of latent heat, so that 22 per cent of this can be absorbed to heat 1.25 lbs. of feed water.

Considering the total production of exhaust steam at an electric station during each 24 hours, it is thus evident that not more than 22 per cent of its weight can be condensed to heat the supply of feed water for the entire day. If, therefore, the excess of exhaust steam over the demands of a heating system, during the hours of heavy load is more than 22 per cent of the exhaust for the day, a part of this excess must be consumed in condensers or otherwise, or else wasted. To store the latent heat of 22 per cent of the total production of exhaust steam during each 24 hours in feed water will require a large tank, but its size is warranted by the saving to be effected.

To illustrate the size of feed water tank that would be necessary

to store the latent heat of 22 per cent of the exhaust steam at an electric station of moderate capacity, during 24 hours, take the following case: Let the total daily output at an electrical station be 5000 kw-hours, the exhaust steam corresponding to 22 per cent of which is to have its heat stored. Then the steam whose heat is to be stored is that produced with 1100 kw-hours, or at 36 lbs. of exhaust steam per electrical unit, 39,600 lbs. As water heated from 40 to 212 degs. absorbs 173 heat units, the 966 units of latent heat in 1 lb. of steam at atmospheric pressure raises the temperature of 5.6 lbs. of water through this range. The 39,600 lbs. of steam whose heat is to be stored, therefore, require 221,760 lbs. of water, which, at 59.8 lbs. per cubic foot occupies a space of 3708.36 cubic feet. A round tank, 15.5 ft. in diameter and 20 ft. high, holds this amount of water. If feed water for the entire 24 hours at an electric station is heated to 212 degs. by the excess of exhaust steam during the period of heavy load, over the demands of the heating system, the heat of the flue gases can be utilized to still further raise the temperature of the feed water. As steam at a gauge pressure of 100.3 lbs. has a temperature of 338 degs., 128.6 heat units may be added to each pound of boiler feed water after it reaches the temperature of 212 degs., if boilers are operated at the pressure named. This use of flue gases to raise the temperature of feed water above 212 degs. will absorb a large per cent of their heat and enable rapid changes to be made in the steam output of boilers. To determine the efficiency of a combined electric and steam heating station, in the generation and distribution of energy from coal, it is necessary to take account of both the heat and electricity delivered to consumers.

The reasonable assumptions previously made show that for each electrical unit or kw-hour delivered by the station with 10 lbs. back pressure on the engine, the boilers must supply 45 lbs. of steam, of which 36 lbs. will come from the engine cylinders as exhaust steam and 9 lbs. as water. Forty-five lbs. of steam at 100 lbs. gauge and 10 lbs. back pressure per kw-hour is about equivalent to 40 lbs. per kw-hour at the same gauge and 2 lbs. back pressure. The 36 lbs. of exhaust, when reduced to atmospheric pressure, yield $966 \times 36 = 34{,}776$ heat units for the pipe system. If a part of this heat is stored in feed water, and then subsequently taken from the boilers, through a reducing valve, into the distribution pipes, the result is the same. The 45 lbs. of steam, at 100 lbs. gauge pressure, per kw-hour of electric energy, absorbs $1177 \times 45 = 52{,}965$ units of heat above feed water at 40 degs. temperature. Exhaust steam from engines driving dynamos may, therefore, deliver for the heating system $34{,}776 \div 52{,}965 =$ 66 per cent of the heat taken from the boilers by engines. The average efficiency of the steam distribution pipes has been found to be 59 per cent where only the latent heat of steam is used and 74 per cent where the heat can be extracted from the water of condensation down to a temperature of 40 degs. Considering only the latent heat of exhaust steam, consumers may, therefore, receive $80 \times .66 \times .59 = 31$ per cent of the energy of the fuel, consumed under boilers of 80 per cent efficiency, to drive engines for electric stations. If the heat equivalent of 1 kw-hour, or 3412 heat units is reduced to a per cent of the fuel energy it becomes $(3412 \div 52{,}965)\ .80 = 6.4$ per cent. The combined heat and electric energy supplied to consumers is thus $31 + 6.4 = 37.4$ of that taken from fuel, where the condensed exhaust is wasted. Where the temperature of the condensed exhaust can be reduced to 40 degs. by indirect heating coils, the efficiency of distribution becomes 74 per cent, and the portion of fuel energy delivered by the exhaust steam is $80 \times .66 \times .74 = 39$ per cent. The total efficiency in this last case is $39 + 6.4 = 45.4$ per cent. As the simple steam heating system has an efficiency of 47 per cent, the coal that an electric station must burn in order to distribute a given amount of heat with exhaust steam is therefore $47 \div 31 = 1.5$ times the amount necessary at an independent heating station for the same heat distribution. When steam at an electric station is taken from the boilers for the heating system, either through reducing valves or from boilers operated at low pressure, about the same efficiency as to heat distribution can be had with this steam as would be possible at a simple heating station.

The supply of the steam distribution system of an electric station in part directly from the boilers, makes it practicable to store the latent heat of more than 22 per cent of the exhaust steam in feed water, because in this case all of the feed water does not enter the engines as steam. For electric stations that can use a weight of steam for heating at least equal to their total amount of exhaust with simple engines, there is little or no advantage in the operation of compound engines. The pressure of 10 to 15 lbs. above the atmosphere, that must be maintained in the distribution pipes for steam heating from a central station, operates to reduce engine power in nearly the proportion of the total back pressure to the mean effective pressure of boiler steam in a simple engine. Where a compound engine is used this back pressure operates against the piston in the low-pressure cylinder, and as this piston may have an area 2.5 to 3 times as great as the piston in a simple engine of equal power, the advantage of the compound engine over the simple as to steam consumption for a given power may be more than offset, even where the total exhaust is not used for heating.

## Elements of Illumination—XX.

By Dr. Louis Bell.

### THE ELECTRIC ARC.

THE electric arc is the most intense artificial illuminant and the chief commercial source of very powerful light. A full account of it would make a treatise by itself, so that we can here treat only the phases of the subject which bear directly on its place as a practical illuminant. First observed probably by Volta himself, the arc was brought to general notice by Davy in 1808 in the course

FIG. 1.—ENLARGED VIEW OF CARBON TIPS

of his experiments with the great battery of the Royal Institution. If one slowly separates at any point an electric circuit carrying considerable current at a fair voltage the current does not cease flowing when the conductor becomes discontinuous, but current follows across the break with the evolution of great heat and a vivid light. If the separation is at the terminals of two carbon rods the light is enormously brilliant and by proper mechanism can be maintained tolerably constant. The passage of the current is accompanied with immense heat, and the tips of the carbon rods grow white hot, and serve as the source of light. In an ordinary arc lamp the upper carbon is the positive pole of the circuit, and is fed slowly downward, so as to keep the arc uniform as the carbon is consumed. The main consumption of energy appears to be at the tip of this positive carbon, which is by far the most brilliant part of the arc, at which the carbon fairly boils away into vapor, producing a slight hollow at the center of the upper carbon, known as the "crater." The carbon outside the crater takes the shape of a blunt point, while the lower carbon is rather evenly and more sharply pointed, and tends, if the arc is short, to build up accretions of carbon into somewhat of a mushroom shape. Fig. 1 shows the shape of these tips much enlarged, as they would appear in looking at the arc through a very

dark glass. Under such circumstances the light from the arc between the carbon points seems quite insignificant, and it is readily seen that the crater is by far the hottest and most brilliant feature. In point of fact the crater is at a temperature of probably 3500 degs. to 4000 degs. F., and gives about 50,000 cp per square inch of surface —sometimes even more.

It is tolerably obvious that the more energy spent in this crater the more heat and light will be evolved, and that the concentration of much energy in a small crater means a tremendously powerful arc. It is not surprising therefore to find that the larger the current crowded through a small carbon tip, in other words, the higher the current density in the arc the more intense the luminous effects and the more efficient the arc. Fig. 2 shows this fact graphically, giving the relation between current density and light in an arc maintained at uniform current and voltage. The change in density of current was obtained by varying the diameter of the carbons employed, the smallest being about 5-16 in. in diameter, the largest ¾ in. The current was 6.29 amperes, and the voltage about 43.5. The efficiency of the arc appears from these experiments to be almost directly proportional to the current density. But if the carbon is too small it wastes away with inconvenient rapidity, while if it be too large the arc does not hold its place steadily and the carbon gets in the way of the light.

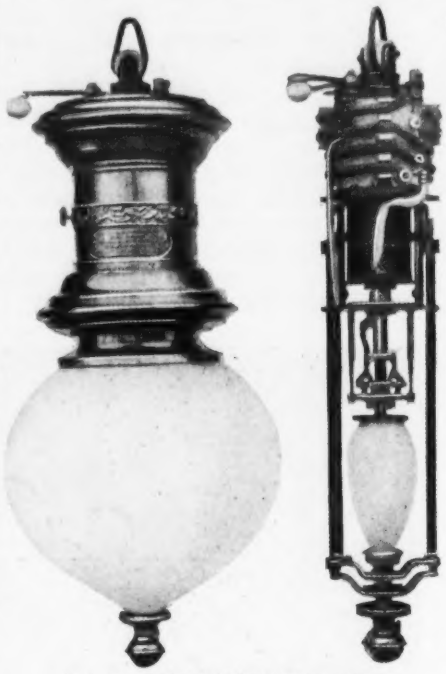


FIG. 3.—TYPICAL ENCLOSED ARC LAMP.

The higher the voltage the longer the arc that can be successfully worked, but here again there are serious limitations. With an arc too short the carbons are in the way of the light, and the lower carbon tends to form mushroom growths, which interfere with the formation of a proper arc. In arcs worked in the open air the arc is ordinarily about 3-16 in. long. If the voltage is raised above the 40 to 45 volts at the arc commonly employed for open arcs, the crater temperature seems to fall off and the arc gets bluish in color from the relatively larger proportion of light radiated by the glowing vapor between the carbon poles.

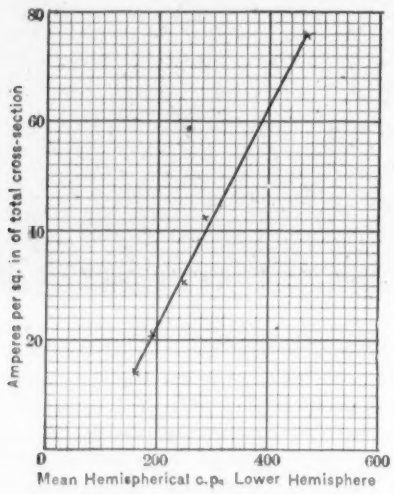



FIG. 2.—RELATION BETWEEN CURRENT DENSITY AND LIGHT.

So it comes about that commercial arcs worked in the open air generally run at from 35 to 50 volts, and from 6 to 10 amperes. The softer and finer the carbons the lower the voltage required to maintain an arc of good efficiency and proper length, so that arcs can be worked successfully at 25 or 30 volts with proper carbons, and with very high efficiency, but at the cost of burning up the carbons rather too rapidly. Abroad, where both high-grade carbons and labor are cheaper than in this country, such low voltage arcs are freely used with excellent results, and a greatly increased efficiency.

Sometimes three are burned in series across 110-volt mains, where in American practice one or at most two arc lamps would be used in series with a resistance coil, the same amount of energy being used in each case. The upper carbon burns away about twice as fast as the lower, and the rate of consumption is ordinarily from 1 to 2 inches per hour, according to the diameter and hardness of the carbons.

The carbons themselves are generally about ½ in. in diameter, and one or both are often cored, i. e., provided with a central core perhaps 1-16 in. in diameter of carbon considerably softer than the rest. This tends to hold the arc centrally between the carbons and also steadies it by the greater mass of carbon vapor provided by the softer portion. Generally it is found sufficient to use one cored and one solid carbon in each arc, although in this country arcs burning in the open air usually are provided with solid carbons only.

In this country such open arcs are very rapidly passing out of use, and are being replaced by the so-called enclosed arcs. During the past three or four years these have gone into use in immense numbers until at the present time the open arc is very rarely installed, and illuminating companies are discarding them as rapidly as they find it convenient to purchase equipment for the enclosed arcs.

The principle of the enclosed arc is very simple. It merely consists in fitting around the lower carbon holder a thin elongated vessel of refractory glass with a snugly fitting metallic cap through which the upper carbon is fed, the fit being as close as permits of proper feeding. The result is that the oxygen is rapidly burned out of the globe, and the rapid oxidation of the carbon ceases, the heated gas within checking all access of fresh air save for the small amount that works in by diffusion through the crevices. The carbon wastes away at the rate of only something like ⅛ in. per hour under favorable circumstances, and the lamp only requires trimming once in six or eight full nights of burning, instead of each night. For all-night lighting it used to be necessary to employ a double carbon lamp in which were placed two pairs of carbons, so that when the first pair was consumed the second pair would automatically go into action and finish out the night. The enclosed lamp burns 100 hours or more with a single trimming. Even much longer burning than this has been obtained from a 12-in. carbon, such as is customarily used, but one cannot safely reckon on a better performance without very unusual care. Fig. 3 shows a typical enclosed arc lamp, both with and without its outer globe and case, of the description often used on 110-volt circuits. The nature of the inner globe is at once apparent, but it should also be noted that the clutch by which the carbon is fed acts, as in many recent lamps, directly upon the carbon, thereby saving the extra length of lamp required by the use of a feeding rod attached to the carbon. Finally, at the top of the lamp is seen a coil of spirally wound resistance wire. The purpose of this is to take up the difference between 110 volts, which is the pressure at the mains, and that voltage which it is desired to use at the arc and in the lamp mechanism.

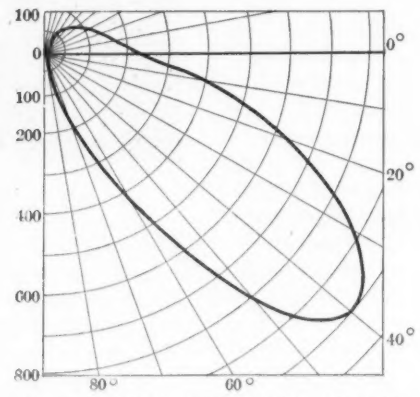



FIG. 4.—AVERAGE DISTRIBUTION OF LIGHT.

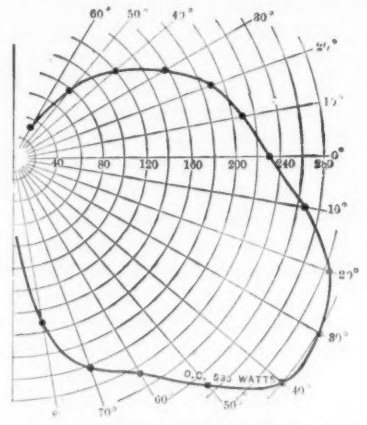



FIG. 5.—COMPOSITE DISTRIBUTION CURVE.

Such a resistance evidently involves a considerable waste of energy, but in the enclosed arc the voltage at the arc itself is rather high of necessity, 70 to 75 volts, so that the waste is less than it would otherwise be.

It has been found that when burning in an inner globe without access of air, the lower or negative carbon begins to act badly, and build up a mushroom tip when the voltage falls below about 65 volts.

Hence it is necessary to the successful working of the scheme that the arc should be nearly twice as long as when the carbons are burning in open air. This has a double effect, in part beneficial, in part harmful. With the increased length the crater practically disappears, and the light is radiated very freely without being blocked by the carbons. Hence the distribution of light from the enclosed arc is much better than from an open arc. On the other hand, there is no point of the carbon at anything like the temperature of the typical open arc "crater," and the intrinsic efficiency is thereby lowered. Also if the enclosed arc is to take the same energy as a given open arc the current in the former must be reduced in proportion to the increased voltage, hence, other things being equal, the current density is lowered, which also lowers the efficiency.

The compensation is found in the lessened care and the lessened annual cost for carbons. The carbons themselves have to be of a special grade, and are about two and a half times the cost of plain solid carbons, but the number used is so small that the total cost is low. There is some extra expense on account of breakage of the inner globes, but the saving in labor and carbons far outweighs this. Moreover, the light, albeit somewhat bluish white, is much steadier than that of the ordinary open arc, and the inner globe has material value in diffusing the light, being very often of opal glass, so that the effect is much less dazzling than that of an open arc, and the light is far better distributed.

In outdoor lighting the greater proportion of horizontal rays from the enclosed arc is of considerable benefit, while in buildings the same property increases the useful diffusion of light, as will be presently shown. Of course, when enclosed arcs are operated in series as in street lighting the resistance of Fig. 3 is reduced to a trivial amount or abolished, so that the extra voltage required with the enclosed arc is the only thing to be considered. The enclosed arc used in this way is very materially better as an illuminant than an open arc taking the same current, and experience shows that it may be substituted for an open arc taking the same energy with general improvement to the illumination.

The weak point of the open arc is its very bad distribution of light, which hinders its proper utilization. The fact that most of the light is delivered from the crater in the upper carbon tends to throw the light downward rather than outwards, and much of it is interrupted by the lower carbon. Fig. 4 gives from Wybauw's experiments the average distribution of light from 26 different arc lamps, representing the principal American and European manufacturers. The radii of the curve give the intensities of the light in various angles of a vertical plane. The distribution of light in space would be nearly represented by revolving this curve about a vertical axis passing through its origin, although at any particular moment the distribution of light from an arc may be far from equal on the two sides. The shape of the curve is approximately a long ellipse with its major axis inclined 40 degs. below the horizontal. The presence of globes on the lamps may modify this curve somewhat, but in ordinary open arcs it always preserves the general form shown. The small portion of the curve above the horizontal plane shows the light derived from the lower carbon and the arc itself, while the major axis of the curve measures the light derived from the crater. The tendency then of the open arc is to throw a ring of brilliant light downward at an angle of 40 degs. below the horizontal, so that within that ring the light is comparatively weak and without it there is also considerable deficiency. Hence the open arc, if used out of doors, fails to throw a strong light out along the street while it is dazzling when near the lamp. For the same reason the open arc is at a disadvantage in interior lighting for the reason that most of the light being thrown downwards, falls upon things and surfaces far less effective for diffusion than the ordinary walls and ceiling. Hence one of the very best ways of using arcs for interior lighting is to make the lower carbon positive instead of the upper, and to cut off all the downward light by a reflector placed under the lamp. Then practically all the light is sent upward and outward to be diffused by walls and ceiling.

The enclosed arc, on the other hand, gives a much rounder, fuller curve of distribution, the light being thrown well out toward the horizontal and there being a pretty strong illumination above the horizontal. For the same energy the maximum illumination is little more than half the maximum derived from an open arc, but the result in distribution is such as to fully compensate for this difference if one considers the lamps as illuminants and not merely as devices for transforming electrical into luminous energy.

Fig. 5 shows a composite distribution curve from ten or a dozen enclosed arc lamps, such as are used on constant potential circuits, including various makes. Most of them were lamps taking about 5 amperes, and therefore using nearly 400 watts at the arc, besides the energy taken up in the resistance and the mechanism. Figs. 4 and 5 afford a striking contrast in distribution, and it is at once obvious that the lamps represented by the latter have a great advantage as general illuminants either indoors or outside. These figures include the inner globe, of course, which is generally of opal glass, which is of material benefit in correcting the bluish tinge produced by the long arc. After a few hours burning a slight film collects on the inner globe, which tends to the same effect. For interior lighting, outer globes of opal or ground glass are generally added, so that the color question is practically eliminated. As ordinarily employed, enclosed arc lamps take from 5 to 7 amperes, although now and then 3 or 4 ampere lamps are used. These smaller sizes are less satisfactory in the matter of color of the light, and are not widely used. Abroad open arcs taking as little as 2.5 amperes are sometimes used. The carbons in this case are very slender and of particularly fine quality, and these tiny lamps can be made to give a brilliant and steady light. Outside of America the enclosed arc is little used, for abroad labor is much cheaper than here, and carbons of a grade costly or quite unattainable here are there reasonably cheap, so that the somewhat higher efficiency of the open arc compensates for the extra labor and carbons.

At its best the electric arc has about three times the efficiency of a first-class incandescent lamp, but this advantage is somewhat reduced by the need of diffusing globes to keep down the dazzling effect of the arc, and to correct the distribution of the light. Taking these into account, and also reckoning the energy wasted in the resistances in case of arc lamps worked from constant potential circuits, the gain in efficiency is considerably reduced, and if one also figures the better illumiation obtained by using the distributed lights usual in incandescent lighting, the arc lamp has a smaller advantage than is generally supposed. Many experiments bearing on this matter have been made, and a study of the results is highly instructive.

## Transmission System of the Bay Counties Power Company, California.

ONE of the largest transmission undertakings in California has been carried on very quietly, so that it has by no means attracted the attention its size and importance deserves. The company now has power houses of an aggregate capacity of 16,000 hp, with room for enlargement, and in addition to supplying power to towns and mining districts in Yuba and Nevada Counties, northeast of Oakland, is now completing a double 140-mile pole line to deliver power to Oakland and the eastern shores of San Francisco Bay. The transmission line and apparatus is designed for 60,000 volts line pressure.

The Bay Counties Power Company is the result of a consolidation of two companies, which previously owned power plants and supplied power in Yuba and Nevada Counties, viz., the Yuba Electric Power Company and the Nevada County Electric Power Company.

The Bay Counties Power Company now has three power houses. The largest of these is at Colgate on the North Yuba River, which was originally started in September, 1899. It has been enlarged until, when machinery now contracted for is installed, it will have a capacity of 15,000 hp. There will be allowance made for extending this plant still further. The water is supplied by a flume 7.6 miles long, 7 ft. wide and 6 ft. deep, with a drop of 13 ft. to the mile. This flume terminates at a point on the hillside 700 ft. above the power house. Five pipe lines will take the water to the power house. These are cast iron at the bottom and steel at the top, 30 in. inside diameter. In the power house there will be three units of 3000 hp and four units of 1500 hp. Risdon Iron Works impulse water wheels direct-connected to Stanley three-phase generators and governed by Lombard type F governors are adopted for all the units. The large units will run 285 r. p. m., and the small units run 400 r. p. m. The generator voltage is 2400, and this is raised at present writing by transformers connected delta fashion to 24,000 volts for transmission. This will presently be changed to star connection, and consequently 40,000 volts. The new transformers for the 140-mile line to Oakland will give 60,000 volts, and will be connected star-fashion with grounded neutral. They will have three different connections, so that 40,000, 50,000 or 60,000 volts may be obtained. The start will be made at 40,000 volts, and according to the plans this will be raised to 50,000 and 60,000 when the line loss due to increasing load exceeds 10 per

cent. Oil switches are to be put in on all the 2400-volt generator circuits at the power house.

What is known as the Old Yuba power house is 10 miles from the Colgate power house. It operates under a 300-ft head of water supplied by a pipe line 42 in. in diameter. It has three Pelton water-wheels direct-connected to two-phase Stanley generators, giving 2400 volts pressure. This is stepped up to 16,000 volts, three-phase, and is run in parallel with one of the circuits of the Colgate plant not before mentioned.

The South Yuba power house, 5 miles from Nevada City, formerly owned by the Nevada County Electric Power Company, is unique in having two different sources of water and necessarily operating under two different heads. Most of the time it is run by water supplied by a flume, and the head is 290 ft. When this water is low the supply is pieced out with water from a storage reservoir under an 800-ft. head. To accommodate these two different heads each generator has two Pelton wheels direct-connected on its shaft, one for high and one for low head. This plant has four 500-kw Stanley two-phase generators generating at 5000 volts.

Grass Valley, Nevada City, Oroville, Marysville and neighboring mining districts are now being supplied, besides a part of the Sacramento Electric Gas & Railway Company load. A maximum of 800 to 900 hp is being supplied to placer mining dredges alone.

The 140-mile transmission line to Oakland consists of two pole lines side by side, 25 ft. apart. Each pole line carries one three-phase circuit transposed every mile, and a telephone circuit 5 ft. below the power circuit. One circuit is of No. 00 medium hard-drawn copper, and the other of stranded aluminum cable of equal conductivity. It was considered that while aluminum is considerably cheaper it is still an experiment for use on transmission lines, and that the company could not afford to experiment on more than one line for the sake of the saving in first cost. The poles are round Oregon cedar, 35 ft. long, are spaced 132 ft. apart, and were painted with hot carbolinium avenarius around the ground line. The insulators (made by Locke) are porcelain with a very wide lip fastened by a sulphur joint onto a glass insulator with a very long petticoat. This is placed on a high wooden pin. This insulator is the result of experiments by R. H. Sterling, superintendent of the Bay division, who has charge of the construction of the transmission line, and sub-stations at the Oakland end of the line.

The line passes through and will supply Woodland, population 8000; Dickson, 4000; Vallejo, 7000; and other smaller towns. A branch of 12 miles will be run to Napa, 12,000 population. The main business will be in supplying power around the eastern side of San Francisco Bay to smelters, reduction works, powder works, etc. The Oakland Transit Company is also to be supplied with power. The latter sub-station will have three 450-kw motor generator sets, with G. E. 60-cycle synchronous motors driving railway generators. There will be there three 500-kw G. E. transformers in use, and one of the same size in reserve. Each side of the crossing of the Straits of Carquinez, north of Oakland, a 1500-kw sub-station, is being put in where transformers will be placed for 5000-volt distribution. Each sub-station is to have three transformers in use, connected star on primary and delta on secondary, and one in reserve, and all transformers have regulating heads on the secondaries for varying the voltage.

One of the most novel and interesting features of the transmission aside from the high voltage is the crossing of the Straits of Carquinez with the transmission line. This is to be done with a span 4700 ft. long. Four ⅞-in. Roeblings steel cables, three in use and one in reserve, will make the enormous span. Steel towers were built by the Pacific Bridge Company on high ground, each side of the Straits, over which the cables pass. There will be 12 tons strain on each cable, and the design of 60,000-volt insulators for taking the strain and also for sustaining the weight was a nice problem. The weight is taken by porcelain insulators ,and the strain insulators depend on micanite to withstand the heavy pressure.

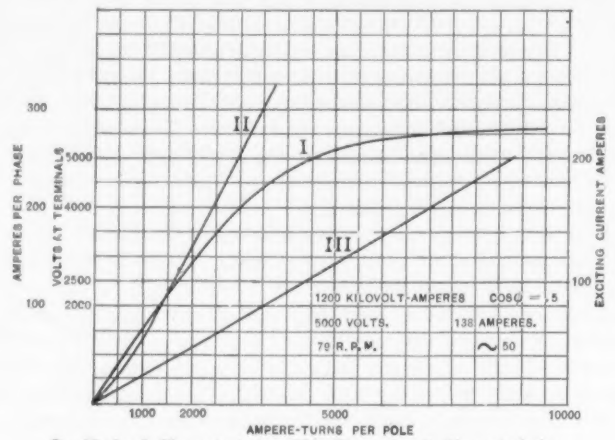
The officers of the Bay Counties Power Company are E. J. De Sabla, president and general manager; W. H. Pierson, vice-president, and C. R. Grow, secretary. R. H. Sterling is superintendent of the Bay division; T. E. Theberath superintendent of the Yuba division, and L. M. Hancock superintendent of the Nevada division. The work of these engineers is of unusual interest and importance, as the above account will indicate. It is not a little remarkable that California should have become in this manner the center of power transmission work on such a large scale, transcending in distance anything else of the kind in the world up to date.

## European Types of High-Tension Alternators—V.

By C. F. Guilbert.

### LABOUR ALTERNATOR.

ONE of the alternators of the Société Eclairage Electrique shown at the Paris Exposition (Figs. 46, 47, 47a and 50), where it was direct-connected to a horizontal tandem-compound Dujarin engine, presented a particular interest on account of the smallness of the power factor as stated by the makers, namely, .5 and from the very small drop. The second feature is still more interesting on account of the high voltage for which the machine was constructed—30,000 volts. A feature worthy to be noted with reference to the construction of this alternator is the manner in which the laminations are secured, indicated on the accompanying illustrations, and which has for an effect to increase the rate of the cooling of the armature, with a consequent reduction in the weight of iron employed.

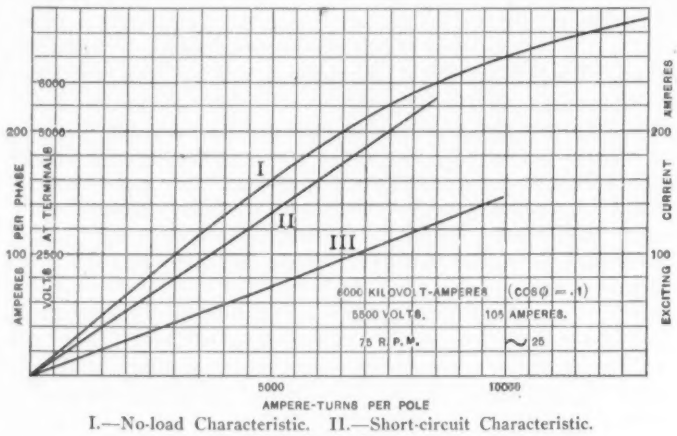



I.—No-load Characteristic. II.—Short-circuit Characteristic.
III.—Excitation line.

FIG. 47A.—CHARACTERISTICS OF LABOUR ALTERNATOR.

### ALTERNATOR OF THE FRENCH THOMSON-HOUSTON COMPANY.

This alternator (Figs. 48, 49 and 49a) was driven by a vertical Allis engine manufactured in France by the Cail Company, and was the only machine of low frequency at the Exposition, having been constructed for sole use with rotary converters. This alternator was one of the lighest, in proportion to its capacity, exhibited at Paris. It was provided with a flywheel weighing almost twice as much as the alternator and almost four times as much as the field of the machine. The magnetic saturation is quite low, which, however, in this case is little with respect to drop, the power factor remaining practically at unity on account of the regulating effect on a circuit of rotary converters.

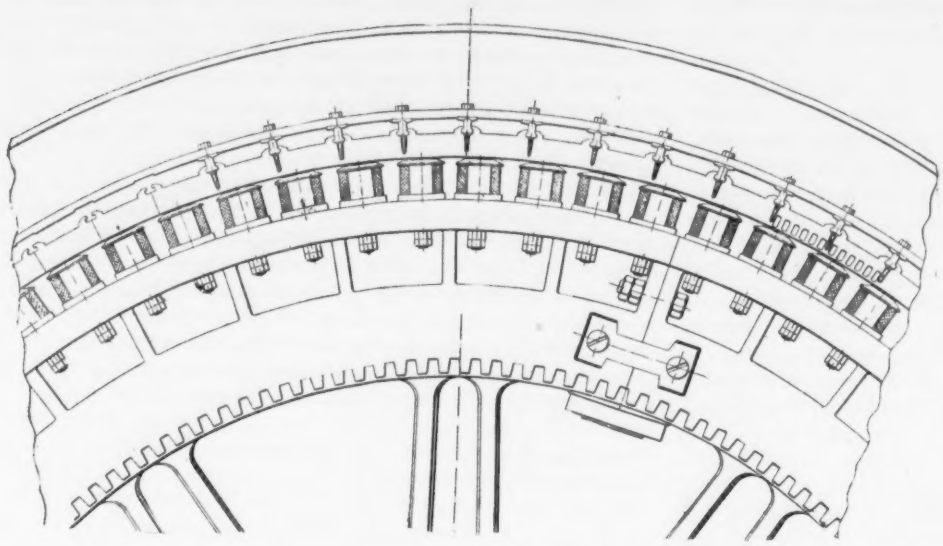


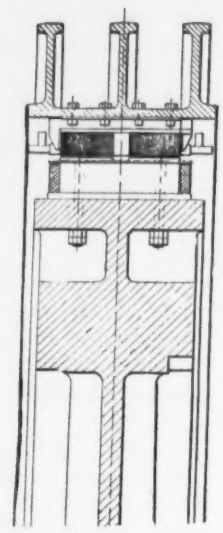

I.—No-load Characteristic. II.—Short-circuit Characteristic.
III.—Excitation line.

FIG. 49A.—CHARACTERISTICS OF THOMSON-HOUSTON ALTERNATOR.

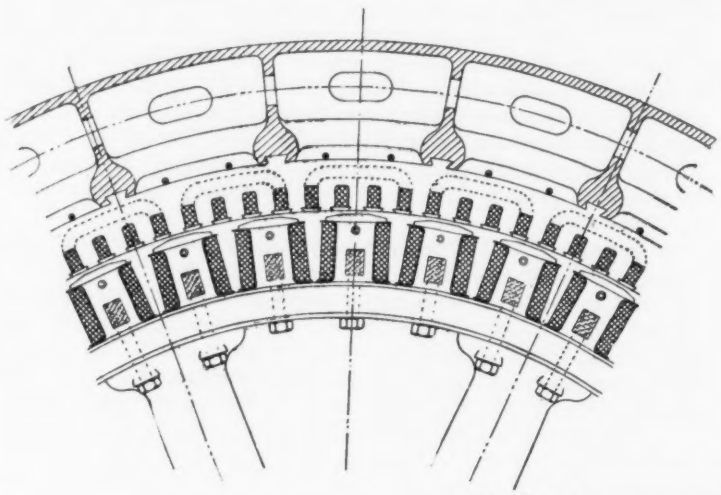
### FARCOT ALTERNATOR.

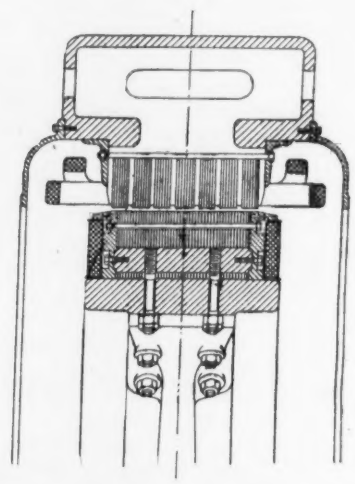
The Farcot alternator exhibited at Paris (Figs. 51 and 52) was direct-connected to an engine from the same works, and is a two-phase inductor machine. Two features are to be noted in connection with this machine, both with respect to its electrical design—the separation of the two phases, the machine in this respect resembling





FIGS. 46 AND 47.—LABOUR ALTERNATOR.





FIGS. 48 AND 49.—THOMSON-HOUSTON ALTERNATOR.

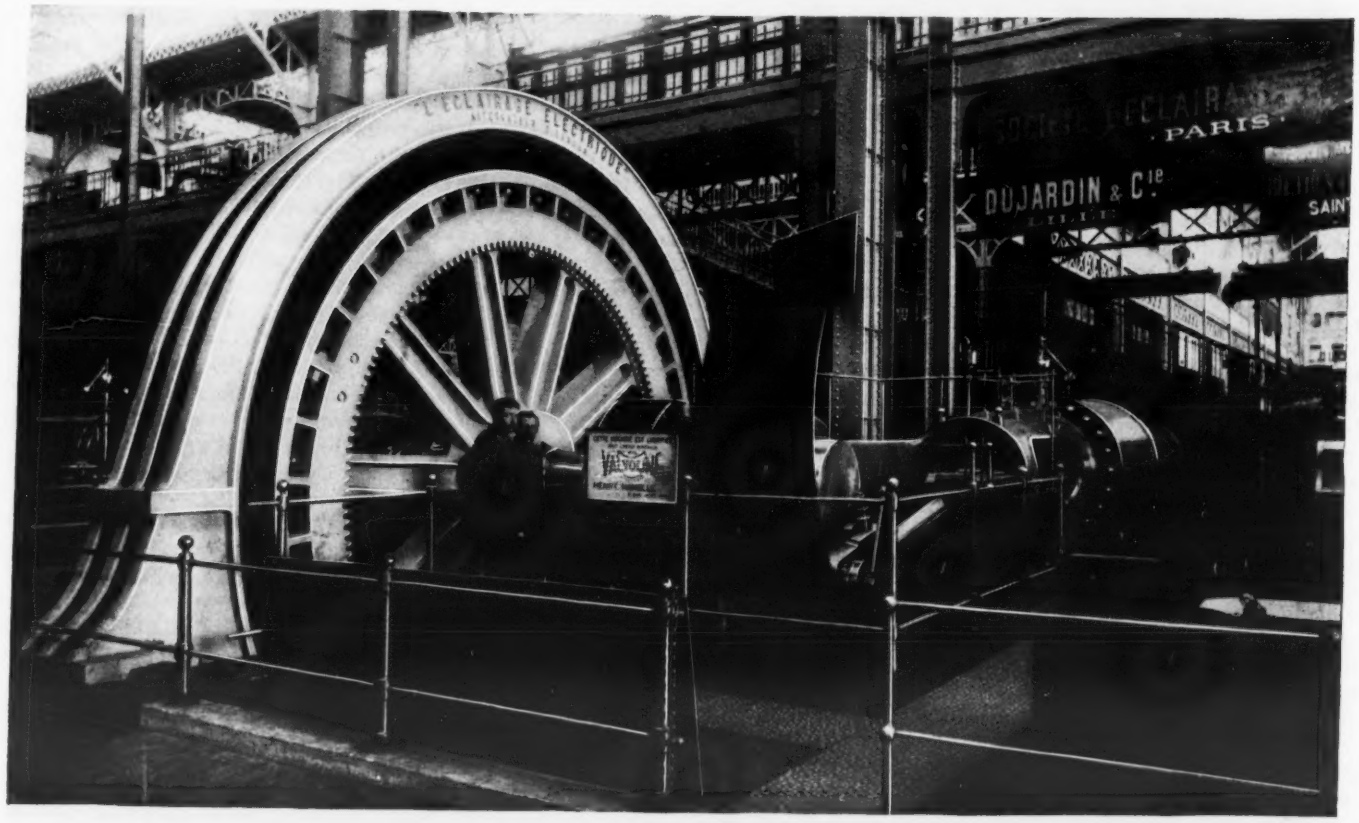
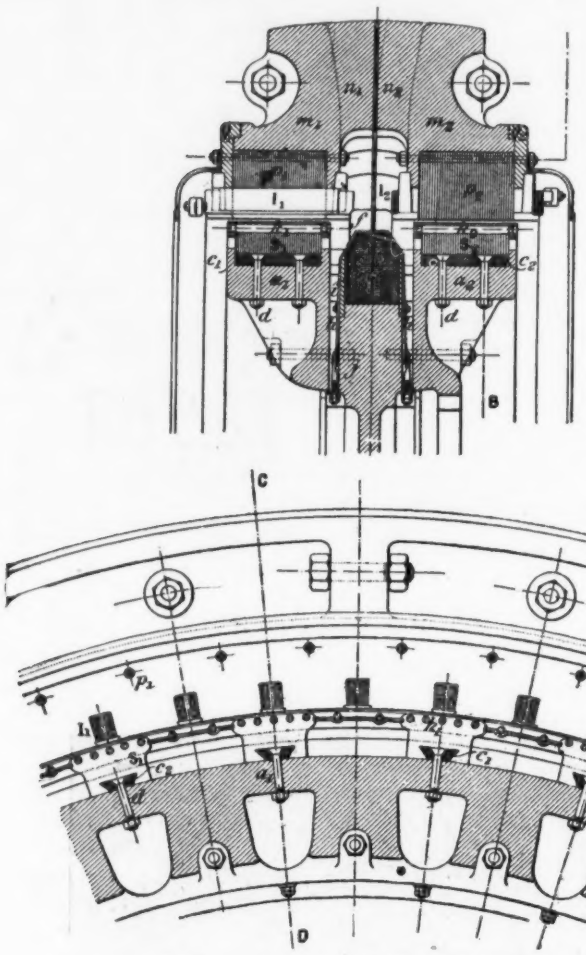



FIG. 50.—PERSPECTIVE VIEW OF LABOUR ALTERNATOR.

the American Stanley alternator; and the employment of the Hutin & Leblanc amortisseur to lessen the armature reaction flux and to facilitate operation in parallel.

The Hutin & Leblanc amortisseur consists of a cylindrical cage formed of copper rods axially arranged, there being 5 rods per pole, and two between each pole—riveted to two copper rings, thus forming a squirrel-cage construction identical with that of polyphase motor armatures. The principle of action is as follows:

In polyphase machines the flux due to the currents in the armature is constant and turns in space with the same velocity as the field flux and in the same direction. It is thus stationary with respect to the amortisseur circuits which, consequently, are not acted upon. In single-phase armatures—which classification includes the Farcot armatures—the flux due to the armature current is, on the contrary, an alternating flux, which can, as the MM. Hutin and Leblanc have shown, be decomposed into two fluxes both revolving with a velocity




FIGS. 51 AND 52.—FARCOT ALTERNATOR.

equal to that of synchronism, but in contrary directions. We can thus consider the ampere-turns of the armature as a resultant of two constant magnetomotive forces, each having a value one-half the maximum value of the alternating ampere-turns into the factor $4\pi$ nearly; and turning, one in the same sense as the field and with its speed, and the other in the opposite direction. The first is thus fixed with respect to the field and consequently with respect to the amortisseur circuits, and the flux which it produces will thus induce no e. m. f. in these circuits which consequently are not affected by this component. The second, on the contrary, is displaced with respect to the amortisseur circuits with a speed double that of synchronism and tends to produce a flux in the circuit giving rise to an e. m. f. of double the frequency of that furnished by the alternator, thus producing currents giving rise to a number of ampere-turns practically equal to and opposed to those of the second magnetomotive force considered. In reality, the part corresponding to the armature flux will be practically nullified, for there will pass through the amortisseur circuits only the flux necessary to produce the e. m. f. lost in their ohmic resistance, and thus can be made as small as may be. The field ampere-turns, aside from the production of the flux necessary to give rise to the no-load voltage in the armature, will thus only be required to counterbalance the ampere-turns of the first rotating field mentioned, neglecting magnetic leakage.

The preceding explanation applies to all the types of single-phase armatures—separate pole and inductor. It may, however, be objected in the case of the latter machines, that the reactive flux of the armature will traverse the solid mass of the armature frame and consequently diminish the effect of the amortisseur; but this objection will only apply to the case of an alternator furnishing wattless current.

Prof. Blondel has lately shown the great value, from the point of view of the theory of alternators, to be derived from the resolution of the armature current into two components—one in phase with induced e. m. f. and the other in quadrature with it. This resolution applied to the armature flux shows that only the *direct* flux due to a wattless current—a maximum when the poles of the field are opposite the induced coils—follows the same path as the field flux. The *transverse* flux, which is of much more importance with respect to a machine, as in this case, with a high-power factor, is, on the contrary, a maximum when the field poles are opposite the slots of the armature, and is consequently half destroyed solely by the action of the amortisseur circuits.

## Train Lighting in Germany.

At a recent session of the German Parliament the Offenbach railway disaster, which occurred on Nov. 8, 1900, through which 12 persons lost their lives and which shocked the entire population of Germany, was taken up for discussion. The question before the Government was as follows: What precautionary measures have the authorities taken, or what measures do they intend to take to prevent similar catastrophies in the future? The Minister of Public Works, Von Thielen, declared himself ready to reply at once, but the floor was given to Repr. Funck, whose remarks may be summed up as follows:

He briefly related the details of the collision, and then expressed a doubt as to whether the results would have been as disastrous if it had not been for the presence of the gas retorts. The lighting of railway cars has been considerably improved since the gas has been mixed with acetylene, but the latter also increases the danger of explosions. The postal cars are already equipped with electric lights. Cannot such a system be introduced on the entire train? In other countries electric-light equipments have been introduced with gratifying results. Eventually the authorities will be forced to introduce the electric light, certainly on passenger trains. In America the work is being pushed vigorously, and in their own country equipments are continuously being made along this line. Even without propelling the cars electrically, electric lighting may be introduced. It affords greater safety, and the danger of short circuits is not to be entertained in view of the low voltages employed. If the authorities desired to wait until an absolutely perfect system has been invented, the Prussian railway cars would never be lighted electrically. Did the other municipalities wait so long? The members of the Elektrotechnische Gesellschaft, of Berlin, have offered to equip trains electrically. The State engineers certainly are equally capable. Why do the authorities hesitate? They fear the expense! Is this always the correct businesslike standpoint? Would any private undertaking be content with such a one-sided point of view? The speaker then referred to the inadequate signal system in use in that section of the country and the small force of men employed at the various signal stations. The system of economy, said he, plays too important a part in their railway system.

The Minister of Public Works, Von Thielen, then replied by referring to his personal regret and sorrow over the awful accident. He defended the Government by denying the false economy attributed to it, and referred to the large sums of money which had been spent within recent years for railway safety devices. The responsibilities of his important office are not as burdensome, stated the Minister, as the daily care and anxiety which is the outcome of the fact that about 6,000,000 people are daily transported over the Government railways. In 1897 26,000 trains were dispatched during 24 hours, which number has grown during the past three years. Every morning and evening the thought is foremost in his anxious mind whether these 26,000 or 30,000 trains will all arrive safely at their destinations. Economy is certainly a virtue, but economy in railway management is only a virtue in theory and not in practice. He then referred to the improvements in track and roadbed construction and the complete renovation of all switches, making them all work automatically. The steam locomotives have been greatly improved. The passenger cars are equal to those in any other country, and the freight cars undoubtedly superior. The employees are re-

ceiving higher salaries and their hours of labor have been shortened. In this respect he claimed the German Government to be considerably in the lead. Ministers and Consuls are in constant touch with engineers, and keep the Government informed of the latest improvements in the railway field, and they frequently send their engineers to such places as might be referred to, in order to find out for themselves whether the improvements are suited for German conditions. During the last 10 years they have introduced the electric block signals more extensively than any other country or railroad company. The Minister then laid particular stress on the fact that every employee of the system must be exonerated, and that any damage suits which may be brought against the Government will receive prompt and careful consideration.

By means of photographs taken of the wreck and by relating what was considered by the Government to be the real cause and manner of the accident, the Minister endeavored to show that the gas which leaked out of the punctured gas retorts did not explode. This was said to be substantiated by the fact that the retorts were found intact after the fire had been extinguished. Then followed a detailed description of that section of the road on which the collision occurred and a description of the block signal system employed. The Minister then defended the cars, known as D-cars, and which had the doors at the two ends, by stating that they were far stronger than the old-fashioned cars which were weakened by a large number of side doors.

"In regard to the gas mixture," continued the Minister, "which we employ for the illumination of the cars, i. e., an oil gas with acetylene, I wish to state that it is not explosive under any circumstances. Extensive experiments have shown this to be a fact. It simply cannot be brought to the point of explosion. About 105,000 cars are equipped with this mixed gas and 8000 with electricity. Even in America, only a small proportion of the 135,000 cars are lighted by electricity, and in that country, as well as in England, the mixed gas industry, as referred to above, makes rapid progress. The postal authorities have introduced the electric light, because the men employed on the postal cars have to work at tables and have to move the lamps around constantly. For this purpose the electric light is far more practicable. In the future we shall also introduce electric train lighting, but electrical engineers are not prepared at the present day to offer a thoroughly practical electric railway lighting system which will meet all conditions. The use of accumulators is also not to be recommended, especially in this country, as new cars have to be switched in and out at nearly every large station. The charge has been made against me that I object to the cost of electric equipments. To this I plead guilty, and I consider it my duty to tell you of the cost, because a system must be well perfected before we ought to expend 50,000,000 marks for its introduction. Again, I wish to state that the Offenbach disaster was not caused by the explosion of gas retorts. The latter cannot be placed on top of the cars, as has been suggested, as the weight ought only to be increased toward the bottom."

Representative Sanger then made some pithy remarks on the subject of block signaling, and condemned the small railway station at Offenbach. It may be true, continued the speaker, that there was no gas explosion, but the fire would not have spread so rapidly if it had not been for the gas which leaked out of the retorts. This burns, as is well known, at a temperature of about 1200 degs. The charred woman might have been saved had not the gas escaped and had there been danger exits. Electric lighting is certainly the safer of the two systems. The electric lights might also be attached to the side walls and thus give a better light for reading purposes. If the Government's methods were pursued by a private company and they should hesitate so long before they introduced improvements, the Government would soon force them to adopt different tactics.

The discussion was continued on Jan. 24, when Repr. Macco replied to Minister von Thielen. He expressed the opinion that the Minister's idea of the engineering progress made in the German railway department was too optimistic. "Our railway system," he continued, "should stand at the head of all systems, and we should not permit other countries to surpass us. Our engineers are certainly doing splendid work, but they are not in a position to advise us properly as to how to use their inventions in actual practice. We are largely dependent upon the progress made in other countries." The speaker proved this assertion by a number of references to track construction, rail material, car construction, locomotive building and electric haulage on canals as practiced in Germany and foreign countries. He mentioned the Wannsee road as a triumph for private companies and claimed that the Government deserved no credit for its successful operation. He further approved the Government's methods of obtaining information on technical matters through its consuls, but urged the necessity of appropriating funds for this purpose. He attributed the Offenbach disaster mainly to the fact that the block signal was inoperative during the fog.

Hereupon Minister von Thielen again mounted the platform to reply to the previous speakers. He claimed to be willing at all times to take the responsibility for disasters occurring on the German railway system. He stated that the wages of employees have been increased 80,000,000 marks yearly during the past 10 years. Speaking of improvements on the railway system he mentioned the unsuccessful attempt to adopt a serviceable coupler for cars. He spoke of the introduction of electricity on trunk lines, saying that the large companies are still experimenting in that respect. He expressed himself in favor of electric haulage on canals.

The next speaker was Repr. Fritzen, who expressed the hope that electric lighting would soon be introduced on German railways, saying that he would gladly sacrifice light-giving power for safety. Repr. Felisch plainly stated that if the gas retorts could not be placed in a position where they would not explode or be punctured, then electricity should be introduced, and if this is not feasible, then one ought to go back to the oil lamps. Rather safety than brilliant illumination.

On Jan. 18 the *Frankfurter Zeitung* replied to the remarks of Minister von Thielen, reaching the conclusion that the Government is opposed to the electric lighting of trains, cynically summing up its remarks as follows: On account of the great expense to be incurred in case it were decided to introduce electricity the mixed gas appears brighter and safer, for that reason the acetylene gas is harmless; for that reason the fires in motorcars due to short circuits are pointed out; for that reason all foreign and local post office or car electric light installations count for naught; for that reason the remark that there was no gas explosion, but simply a leakage of gas. As if death due to an explosion were not to be preferred to being slowly roasted to death.

## German Canal Bill.

The text of the new Canal Bill before the Reichstag embodies an extension of the scheme of 1899, which proposes to connect the Rhine with the Elbe by means of a canal navigable for vessels of considerable tonnage and to canalize the Weser from Bremen to Minden, where the canal would cross it. Among the many objections brought against this plan was the charge that it would benefit only the western half of Prussia. The poorer agricultural provinces to the east of the Elbe would, it was urged, actually suffer from the creation of a cheap means of transport which would lessen the price of foreign agricultural produce on the Berlin market. The Government now has expanded the original bill into a measure providing for the extension of the canal system in all parts of the kingdom. This will, of course, involve a much greater expenditure. It contains seven different schemes, embodying considerable electrical work, of which the total cost to the State is estimated at $100,000,000. These include the Rhine-Elbe Canal; a ship canal between Berlin and Stettin; a waterway connecting the Oder and the Vistula, with a channel rendering the Warthe navigable for ships from Posen to the junction of the Netze, and a canal connecting the province of Silesia with the canal joining the Oder to the Spree.

## Motor Vehicles in Holland.

Consul Frank D. Hill, of Amsterdam, reports that the use of motor vehicles in Holland is becoming general, and that the prospects for American machines are good. Machines intended for Holland should be made narrower than is customary in America, because the roads are too narrow to permit two machines of 4 ft. 8 in. in width to pass each other. Carriages may not be charged higher than 2200 lbs. per wheel.

## Engineering in Brazil.

We have received from Mr. Adolpho Aschoff, of Rio Janeiro, a handsome pamphlet of nearly 300 pages, being the special number of the *Revista de Engenharia*, issued by the Engineering Club. It is devoted to the proceedings of the Engineering Congress held in December, presided over by Mr. Ozorio de Almeida, one of the best Brazilian engineers.

## A Polyphase Power Distributing Plant for Grain Elevators.

THE Great Northern Elevator Company has now in service for its two elevators in West Superior, Wis., a complete three-phase power plant, which is soon to be greatly enlarged in order to drive the apparatus of a new elevator now being erected. The elevators are owned by the same company that operates a large steel elevator in Buffalo, driven by Niagara power, this elevator being the first to be equipped with electric motors. The more recent equipment in West Superior is of interest owing to the improvements which have been adopted over the arrangements in Buffalo. In the West Superior plant the power is generated in an engine-driven isolated plant, leaving the frequency to be determined by the needs of the motors, whereas in Buffalo the frequency is necessarily, as it is supplied by the Niagara system, 25 cycles. A frequency of 60 cycles per second has been adopted at West Superior. The pressure of the motors is the same in both cases, viz., 440 volts, and the number of phases is also the same, viz., three. In Buffalo all the starting switches and fuses are located in one room, to which signals for starting and stopping the motors are sent from those in charge of the apparatus driven. This is to avoid the danger of arcing or severe sparking in the extremely dusty and combustible locations of an elevator. In West Superior the switches and fuses are located near the motors, and are enclosed in dust-proof cast-iron boxes, each switch having an extended shaft coming through the casing of the box and furnished with a hand wheel by which it is thrown from the off to the starting or to the running position. The switches are of the usual auto-starting type of the Westinghouse Company, this company having built the entire electrical equipment.

The Great Northern Elevator Company at present operates two elevators in West Superior, one with a capacity of 1,800,000 bushels and the other with a capacity of about 1,500,000 bushels. Both of these are wooden buildings. A new steel elevator with a capacity of some 3,000,000 bushels is now under construction. The two existing elevators were originally driven by their own steam plants, each having an engine of sufficient size to drive the whole equipment; this engine being, of course, underloaded at all times when only part of the elevator was in operation. On account of the fire risk of this class of buildings, they are necessarily located at some distance from each other, so that it is impracticable to drive several of them from one power plant with any other than electrical means. The electrical drive, concentrating several elevators in one plant, permits the use of larger engines with a better load factor, and allows the power plant to be removed a sufficient distance from any of the elevators to prevent the spread of fire from it to them, whereas with mechanical drives, each power house is usually adjacent to an elevator. The sparkless operation of the polyphase motor and its starting arrangements is essential in such dusty and combustible surroundings as the interior of a grain elevator where a direct-current motor, even if enclosed, would, on account of its starter, be a serious risk.

The present elevators in West Superior require when in full operation about 900 hp; the new one will call for about twice that amount of power. The present plant includes a 300-kw, 60-cycle, three-phase alternator, direct-coupled to a Buckeye cross-compound horizontal engine running at 130 r. p. m. The installation is laid out with unusual thoroughness for an isolated plant. For instance, the engine room is served by an overhead traveling crane, and a central condensing equipment and air pump is installed. The generator is of the revolving-armature type, with overhanging teeth and a bar winding, connected up as a continuous or a two-path wave winding, tapped for the three phases at three points situated 120 degs. apart from each other around the armature. The new generating unit which is now being installed will have a 410-kw alternator direct-connected to a single-crank tandem-compound Allis-Corliss horizontal engine, running at 100 r. p. m. These machines will be worked in parallel with each other and, later when the new elevator is finished, with larger units of possibly other speeds and crank arrangements, illustrating the variety of types of engines which are now installed for parallel service, even with 60-cycle machines.

The motors for the old elevators are 22 in number, all of the induction type, and are adapted to the apparatus originally built for mechanical driving. In elevator A 11 75-hp motors with 10 poles, and hence making about 690 r. p. m. at full load, drive the elevator legs, i. e., the long vertical belts with buckets which raise the grain from the lower to the upper floors of the elevator. Each motor is connected by a rope drive to the usual speed-reducing gears which were used when the elevator was mechanically driven. The other five motors in elevator A drive shovel rigs, cleaners and conveyors. All dust and refuse from the cleaners, which is too poor to be sold as screenings, is drawn by means of motor-driven centrifugal fans into a conveying system, by means of which it is carried to the power house. There it passes through a centrifugal separator which extracts it from the blast which conveys it, and delivers it to the storage bin, from which it passes through chutes into furnaces which are especially constructed for burning it. In this way a considerable saving is made in the item of fuel.

In the new elevator there will be 18 75-hp motors for the elevator legs, 9 15-hp motors for 8 cleaner legs and 1 screening leg, 2 25-hp motors for transfer belts, 3 30-hp and 1 15-hp motors for exhaust fans of the dust-conveying system, 4 50-hp motors for 8 groups of cleaners, 1 50-hp motor for the shovel rigs, 1 100-hp for a car haul and 1 20-hp for a transfer table. There will also be a motor-driven passenger elevator, and a complete lighting system. The present elevators are lighted by means of two-phase 110-volt lines obtaining their power from the three-phase 440-volt system by means of two transformers Scott connected. The speeds of most elevator machinery are, as a rule, so low that a double reduction of some kind is usually necessary from the high speeds of induction motors. The reduction which has been tried in the old plant, and which will be generally adopted in the new one, is a rawhide pinion on the motor shaft, meshing with a cut steel gear, which in turn delivers the power to a rope drive or belt.

The work at West Superior is in charge of Mr. A. D. Bellinger, general superintendent of elevators for the company, to whom is due credit for the working out of many of the special mechanical problems in the application of the electric drive, as well as for many structural and other improvements which have been adopted in the new elevator. The electrical work is in charge of Mr. G. Willius, Jr., electrical engineer of the company.

## Equalizer System for Compound Wound Dynamos.

By Charles Brandeis.

The following is a description of a new compound dynamo equalizing scheme devised by the writer, which may be found of interest. The accompanying sketch indicates the main features. Two or more sets of compound dynamos working on two or more sets of positive and negative bus-bars at equal or at different voltages can work on a common equalizer bus. Moreover, the equalizing current between

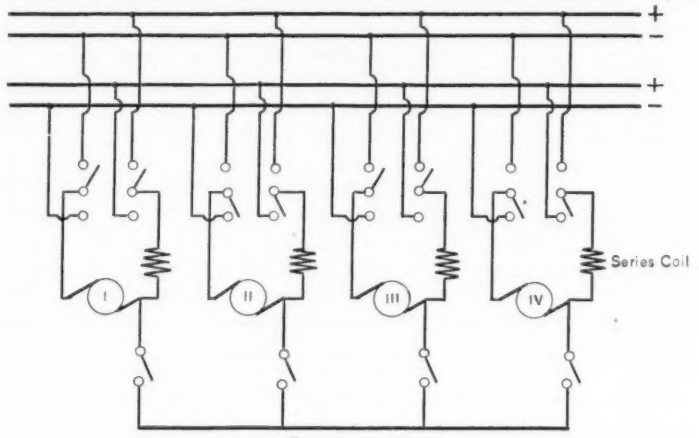



DIAGRAM OF EQUALIZING SYSTEM.

machines of one set will not interfere with any other set, and the equalizing currents of different sets occurring simultaneously will be superimposed in the common conductor without interference. The advantages of this method are its simplicity and the saving in copper involved.

The method is particularly applicable in the case of exciters working on separate bus-bars, which are enabled to excite separate sets of alternators at different voltages. For example, in the plant of the New York Metropolitan Street Railway Company, as described in these columns (page 699, May 12, 1900), it will be seen that the equalizing switches are double-throw, and there are two sets of equalizing buses or cables. With such large units, this means considerable expense. Greater simplicity is introduced by the method

here described, as the equalizing switches can remain closed whether the machines are running or not, and to whatever sets of bus-bars the other switches my be changed over to; and the switchboard attendant has only to change the positive and negative switches on the switchboard. With the Metropolitan plant the equalizing switches are placed next to the exciters, and if the switchboard attendant changes over the positive and negative switches on the switchboard and forgets to run to his machine and change over his equalizer switch first, a disaster might result. A patent is being applied for on this method.

## CURRENT NEWS AND NOTES.

*GOVERNMENT WIRELESS TELEGRAPH.*—Prof. Fessenden and his corps of assistants sent out by the Government to establish wireless telegraph stations down the coast have completed the first installation off Roanoke Island, N. C. The station is not far from Cape Hatteras.

*PARIS AUTOMOBILE SHOW.*—Never before in the history of automobilism in France has there been such a complete show of horseless vehicles made as may be seen in the Grand Palais, Paris, which is thronged every day with a large attendance. There is no doubt that this exhibition will prove of tremendous benefit to the manufacturers of automobiles.

*SEARCH LIGHTS.*—With regard to a recent item in our columns, Schuckert & Co. write us that they exhibited a search light projector at Paris as large as two meters. They had also two of 1.5 meter diameter, corresponding to their Chicago exhibit in 1893. They do not agree with the statement that in war metal mirrors are preferable to glass parabolic ones. "As a matter of fact, metal reflectors are more sensitive than those made of glass as regards destructive influences, and are only kept in good condition with difficulty."

*DR WILLIAM GILBERT.*—Commenting on the scheme of erecting a memorial to Dr. William Gilbert, who, more than 300 years ago, laid the foundations of the science of magneto-electricity, the London *Lancet* says: "We congratulate the medical men of Colchester upon their desire to do honor to their great townsman, while the incident may surely give us all cause for serious thought when we consider how very few memorials, whether statues, medallions or pictures, of our great scientific heroes are to be found in this country." The same thing might well be said in America.

*GASOLINE LAMPS PROHIBITED IN OHIO.*—State Oil Inspectors Frank L. Baird, of Toledo, and John R. Mallow, of Columbus, have issued a positive mandate that all manufacturers of gasoline lamps in the State must discontinue such manufacture and use at once. There are several large factories in Ohio, and many thousand users. It is intended to serve notice on all at first, and if the order is not obeyed in reasonable time radical measures will be taken. It is expected that the manufacturers will fight the matter through the courts. The statutes of Ohio are very positive on the subject, but have never been made effective by former State oil inspectors.

*FREE TELEPHONE SERVICE GIVEN.*—Huntington, W. Va., is one of three cities in the United States where telephone service is had by the public absolutely free of charge. In that town the Bell and a home company are fighting each other tooth and nail, and three years ago the Bell company created a sensation by announcing that, until further notice, its service would be given all subscribers free. This was expected to crush the home company, but, contrary to expectations, it has thrived; its rates have not been cut, and its number of telephones has increased. Of course, there has been an active demand for the free Bell telephones, but the home company is owned largely by local residents. New Philadelphia, Ohio, near Wheeling, is another town where the Bell gives an absolutely free service, owing to the competition of a home company.

*WIRELESS IN A SNOWSTORM.*—In the midst of a Channel snowstorm the Belgian mail steamer Clementine crossed from Ostend to Dover recently and the final official trial of the Marconi system of wireless telegraphy took place with complete success. A dozen Belgian Government officials were on board to witness the trial, before recommending the system for adoption on all the Belgian Channel packet boats, which are operated by the Belgian Government. They were quite satisfied with the day's achievements. In spite of the storm, messages were regularly exchanged between the Clementine and Ostend until the boat drew alongside Dover pier. The result will be the installation of the system on the Belgian boats. It is said that the British authorities have prohibited the use of the Marconi system on the English boats. Mr. Marconi now contemplates establishing stations all round the English coast, to enable vessels at any distance up to 60 miles from land to communicate with the shore.

*SPLIT FIELD POLYPHASE PATENT.*—A decision was rendered last week in the Western Division of the United States Circuit Courts of the Southern District of Ohio enjoining a fan motor company from infringing the first claim of patent 401,520, issued to Nikola Tesla April 16, 1889, on an application filed Feb. 18 of the same year, covering what is generally known as the "split phase" method of starting synchronous motors. This method consists in separating at starting the field into two parts, one of which is fed by a current in phase with that of the line, and the other by a current shifted in phase through the action of inductances contained within this circuit. After the motor has been brought up to speed through the effect of the rotary field produced by the above arrangement, a switch is shifted and the motor then proceeds to act as a purely synchronous motor. One part of the defence lay in the contention that the device of the patent at issue did not constitute an invention, since it merely involved a change in the connections, which was such a simple thing to do as to involve no exercise of the creative faculty of invention. Another part of the defence was based upon patent 407,844, issued July 30, 1889, to Elihu Thomson, on an application filed Nov. 17, 1888, but the Court decided that although in this case the patentee had the question before him of "suitable devices" for "bringing the armature up to full speed or a speed almost synchronous with the rate of alternation speed," he did not accomplish what was accomplished by the patent in suit.

*SCRIBNER TELEPHONE PATENTS.*—Four patents were granted Feb. 5 to Charles E. Scribner on telephone exchange apparatus. The earliest in date of application (Sept. 25, 1896), relates to a system of signals to permit a calling subscriber to indicate by a visible device the group or office in which the required correspondent may be found, thus obviating the necessity of bringing an operator into communication with the subscriber to obtain that information. For instance, in an exchange system comprising a number of different devices, the subscriber whose lines terminate in one office may indicate to the distributing operator in charge of his line, the office with which he requires connection, and the line having been extended by means of a trunk circuit to the designated office, the required connection may be completed at the latter office with a minimum expenditure of labor and time. The specific invention involved consists in the combination with a metallic line circuit, of a signal in a branch from each line conductor; a key at the sub-station controlling each of the signals, and a third key at the same point adapted to cause the display of both signals simultaneously. This device enables the subscribers to give three different signals through the agency of the three keys and two signal-indicating appliances. Preference is given to a source of current at the central office for the line conductors, and the use of small incandescent lamps for visible signals. The second patent in date of application (Jan 9, 1897), relates to the mechanism associated with telephone lines in a switchboard for signaling to the attendant and indicating the use or disuse of the appliances at the station. It also concerns the use of incandescent lamps as secondary signals, controlled by suitable devices directly responsible to signal currents to the lines. The interruption of service by the breaking of this signal lamp is guarded against, and means are provided for setting a general signal before any operator to indicate a call from any of the subscribers under her care, or to serve as a night signal. The third application filed March 9, 1898, is on the construction of small incandescent lamps for use as secondary signals in telephone switchboards, and relates to certain details of structure whereby increased durability together with improved operation is attained. The fourth patent (application filed June 7, 1899), applies to telephone lines equipped with supervisory signals at the telephone switchboard serving to indicate the condition of the apparatus at the sub-stations. The purpose of the invention is to cause the supervisory signals of two united lines to act independently at certain stages during the connection between the lines, and jointly at other times.

*PARIS SURFACE CONTACT ROADS,* recently installed, are said to be giving trouble from short circuits, due in some instances from the use of salt after snow to keep the contact buttons and tracks clear. "The street looked like a battlefield. Men and horses were falling everywhere. The authorities ordered traffic stopped and investigated. Fearing wholesale danger, they talked of forbidding the continuance of the system. The railway company threatened to sue the city for damages if prevented from running, so the restrictions were removed, the authorities simply warning the company against putting salt on the rails."

*WHAT HATH GOD WROUGHT?*—Mr. W. A. Bole, as retiring president of the Engineers' Society of Western Pennsylvania, said recently: "The first message ever flashed across the Atlantic cable was from the good Queen Victoria to our President Buchanan, and the words were these: 'What hath God wrought?' In summing up the results of a century's progress in electrical matters, what more fitting words can be employed than these of the gentle sovereign of our mother country?" Well, that first message was rather dubious, anyhow, but now the good old Queen is dead, some one ought to arise and defend her from this funny charge of plagiarism.

*PATENTS IN ENGLAND.*—The number of patents taken out in England seems to be falling off. The number of applications last year was 23,909. It is the lowest mark reached since 1891. But there is the consolation that 1897 produced 30,936 applications, the biggest number on record. A corresponding falling-off occurred during 1900 in the number of readers at the Patent Office Library. There were 94,864, as compared with 113,397 in 1896. Of the 23,909 applications made last year probably half will be abandoned before next Christmas. Three-fourths of the remainder having become patents will inevitably collapse during 1902, and by 1914 possibly only a meagre remnant of 5 per cent will remain.

*U. S. PATENT OFFICE ANNUAL REPORT.*—The report of the Commissioner of Patents for 1900 shows that during the year there were received 39,673 applications for patents, 2225 applications for designs, 82 applications for re-issues, 2099 applications for registration of trade marks, 943 applications for registration of labels, and 127 applications for registration of prints. There were 26,418 patents granted, including designs, 81 patents reissued, 1721 trade marks registered, and 737 labels and 93 prints. The number of patents that expired was 21,196. The number of allowed applications that were forfeited for non-payment of the final fees was 4215. The total expenditures were $1,200,019. The receipts over expenditures were $90,808. The total balance to the credit of the Patent Office in the Treasury of the United States on Jan. 1, 1901, was $5,177,458.

*TELEPHONE TRANSMITTER.*—A patent was granted Feb. 5 to T. Lidberg on a telephone transmitter claimed to possess all of the resonant and sensitive qualifications of the transmitter of the Blake type, combined with the durability and practical features of the transmitter of the Hunning type. A movable carbon electrode secured to the vibrating diaphragm is enclosed in a cylindrical case, the stationary carbon electrode being within the other end of the same case, and the space between the two filled with granulated carbon. The construction is such that the entire movable system of electrodes is attached to the vibrating diaphragm. The moveable carbon button is attached to a small mica diaphragm, which is permanently secured to one end of the enclosing case. Two diametrically opposite springs bear on the vibrating diaphragm, the pressure or stress thus exerted being claimed to increase the sensitiveness.

*SIGNAL FOR TRUNK LINES.*—A patent was issued Dec. 5 on an application filed Jan. 11, 1897, to F. R. McBerty and J. L. McQuarrie on a signal for trunk lines whereby each of the operators may be apprised of the acts performed by the other and by the subscriber. Means are provided for automatically operating the signals, which latter comprises a lamp before the toll operator controlled by a relay responsive to currents in the subscriber's line, determined by the position of the telephone switch at the subscriber's station; and a lamp before the subscriber's operator which is displayed when the plug is withdrawn from the terminal socket of the trunk line at the toll board. A repeating coil is provided to sever connection between the subscriber's line and the toll line; also a switch for removing the repeating coil from the circuit in special cases, and a device operated by that switch to prevent the display of the signal controlled by the relay when the latter is thus rendered inoperative.

*ROENTGEN RAY SURGERY.*—Prince Kropotkin, discussing recent science in an English magazine, says: "In the hands of an able surgeon—as Prof. E. Bergmann illustrated before the Association of German Naturalists and Physicians in 1899—the X-rays become a most precious means of exploration. Many limbs were saved during the last Greek-Turkish war by Nasse and Küttner continually resorting to radiography. So also in the Soudan war. In fractures of the kneecap the Röntgen rays have proved simply invaluable. But perhaps the best service they have rendered was to demonstrate that in many cases it was far preferable to leave pellets of lead, small revolver bullets, and even Peabody-Martini bullets where they were lodged in the tissues instead of trying to get them out. In fact, Dr. Bergmann's radiograms prove that a bullet may sometimes remain even in the lungs without occasioning any trouble. Such was the case of a German soldier who had carried a bullet in his lungs for 29 years, since 1871, without knowing it."

*NO MUNICIPAL LIGHT IN MONTREAL.*—A few months ago a special committee was appointed by the City Council of Montreal to report upon the best course to adopt in regard to the electric lighting of the city, upon the expiration of the present lighting contract with the Royal Electric Company of that city. The committee did not favor municipal ownership, but recommended that public tenders for the new lighting contract be called for, and that the specifications contain certain conditions which do not apply to the existing contracts. The following objections to muncipal ownership were given: That it would cost the city an immense sum to purchase such a plant; that the city would find it costly to operate it by steam power; that there was an unfavorable outlook of getting water power, without purchasing it from the companies, on account of so many water power companies operating water plants in the vicinity of Montreal; that if water power was bought, it would cost the city as much to manufacture electricity as if produced by coal; and, finally, under these conditions, it would be better to give the lighting out by contract and to have the keenest private competition for the service.

*CHARLESTON EXPOSITION.*—The South Carolina Inter-State and West Indian Exposition will be held in Charleston, S. C., opening Dec. 1, 1901, and closing June 1, 1902. The work of constructing the building is now in active progress, contracts having already been made for four of the principal structures, of which there will be 11. The Exposition Company has its agents actively at work in different parts of the country, and it is expected that the Exposition at Charleston will be one of the completest and most attractive that has ever been given in the Southern States. The recent development of several water powers in the South has introduced a new and progressive factor in determining the placing of manufacturing plants. The demand for electrical appliances has grown steadily, and the most advanced methods are being called into play in arranging the details of the modern cotton mills throughout the South. The field is as yet but sparsely occupied, and electricity is destined to revolutionize methods of obtaining and distributing power through the South. It is thought that the Exposition will afford a good opportunity for the display of electrical apparatus to possible purchasers.

*PHONOGRAPH ATTACHMENT FOR TELEPHONE CIRCUITS.*—A phonograph attachment to a telephone circuit which will transmit messages—such as advertising matter, news matter, etc.—to different subscribers, from a central station without interfering with the conversation between subscribers or operation of the line by operators at the central station, is the subject of a patent granted Feb. 5 to A. B. Clark, of Nashville, Tenn. Means are provided for automatically causing the transmission of phonographic messages to a subscriber on a telephone circuit, independently of any act of the central operator while the subscriber is waiting to be connected with a given line through the central station, and means for cutting off the phonograph circuit at the same time that the operator at the central station connects the subscriber with central or with the line asked for by the subscriber. At the central station is a plug adapted to be inserted in the switchboard, so as to release the spring jacks of a subscriber's line, thereby breaking the connection between the subscriber and phonograph circuit. At the same time the subscriber will be connected with central or with another subscriber through central. A single movement of the operator at the central station thus disconnects the phonograph from a given subscriber when the latter is connected with a given line.

*LONG DISTANCE WIRELESS TELEGRAPHY.*—A special cable dispatch from London of Feb. 12 says: "Prof. John A. Fleming, lecturing at Liverpool to-day, said that he had Signor Marconi's permission to make the first mention of the fact that on the first day of the reign of King Edward VII. Marconi accomplished the feat of sending wireless messages between St. Catherine's, Isle of Wight, and the Lizard, 200 miles. Perfect communication between the two points has since been established .

*ACETYLENE GAS VS. PETROLEUM IN GERMANY.*—Consul Hughes, of Coburg, under date of Dec. 18, 1900, writes as follows: "Up to the present time, Germany has imported each year from $25,000,000 to $30,000,000 worth of American petroleum. This industry, however, seems to be threatened somewhat by the introduction of acetylene as an illuminant, in a convenient and safe form, for house, store and other uses. This has resulted from the low price at which calcium carbide is being produced here, and also from the rise in the cost of petroleum in the German markets."

*THE ELECTRO-CHEMIST AND METALLURGIST.*—The first number of a monthly journal devoted to electro-chemistry and metallurgy has been issued by Sherard, Cowper-Cowles & Co., Limited, 82 Victoria Street, London, England, the subscription price being 6 shillings per year. If we may judge from the first number, just received, it promises to be a valuable addition to the scant periodic literature on electro-chemistry and metallurgy published in the English language. Although there are at present about a half dozen journals devoted exclusively to electro-chemical subjects, yet all but one are in foreign languages. There is therefore a good field for a well edited journal on this branch of the science of electricity in the English language. The name of Cowper-Cowles is already well known to those who have followed the current electro-chemical literature of recent years, and gives assurance that the journal will be intelligently edited. The present number contains the beginning of a serial on recent progress in electro-chemistry, an article by Hutton on the less well-known carbides, borides and silicides, a long illustrated article on electro-chemistry at the Paris Exposition, an article of a theoretical nature on the deposition of metals from mixed electrolytes by Lethfeldt, and an article on the present and future of accumulators by Wade. One of the most interesting and valuable features is a department like our Digest, except that it is limited to electro-chemical subjects, and that the abstracts are as a rule longer but less numerous, and therefore less complete, than in the corresponding department of our Digest. This part of the paper seems to be very well and intelligently edited by Dr. Garrard. The last part of the journal is devoted to illustrated abstracts of the patents of the previous month bearing on electro-chemical subjects. The journal has our best wishes for success.

# LETTERS TO THE EDITORS.

## The Tunneled Armature Winding.

*To the Editors of Electrical World and Engineer:*

Sirs:—In your issue of Dec. 29, 1900, I notice a paragraph entitled "Tunneled Armatures vs. Slotted Armatures," in which the common mistake is made that Mr. Wenstrom was the inventor of the tunnel winding.

Now, Wenstrom invented not a tunnel winding, but one in which the teeth nearly met over the grooves; that is to say, his was the intermediate step between the slot and the hole winding. That he did not think of employing entirely closed holes is quite clear from the wording of his patent, in which he distinctly states that the slits between the teeth shall be filled with some *non-magnetic* material.

The matter is, of course, not of much importance at the present time, but as I have found many people under the same mistaken impression, I thought I would draw your attention to this inaccuracy.

BADEN, SWITZERLAND. C. E. L. BROWN.

[Mr. Brown is correct with regard to the disclosures in the issued Wenstrom patents. However, the Wenstrom machines that were built in Baltimore were constructed with closed tunnels and not with partially closed slots. We also learn that Wenstrom applied for a patent about 1888, in which tunnels of various shapes in cross section were shown, but the patent did not issue for a reason, we are informed, that did not relate to the merits of the invention.—EDS.]

## The Oscillograph and Oscillographic Curves.

*To the Editors of Electrical World and Engineer:*

Sirs:—Referring to the latter of Mr. André Blondel in your issue of Feb. 2, I beg to state:

First, that in my experience the vibrations of the mechanism of an alternating-current arc lamp cannot be relied upon to diminish the amount of steadying resistance under any circumstances. During the period of regulation the vibration of the mechanism at various frequencies produces entirely different results, so that lamp designers aim to keep vibrations out of the regulating mechanism instead of relying upon them. At the feeding point the effect of vibrations is therefore eliminated.

Second, the apparent lag in the alternating arc and the effect of cored and solid carbons upon the arc were known before Prof. Blondel published a description of the oscillograph in 1893. The results of his own work with alternating-current arcs previous to 1893, his modification of the Joubert method are described in *La Lumiere Electrique,* Vol. XLII., page 551, 1891. He corroborated in a brilliant manner with the oscillograph the results of contemporaneous investigations as well as of his own, adding many new and interesting points.

The following references will illustrate the above: *a.*—Tobey and Walbridge's paper on the Stanley alternating-current arc dynamo, *Proceedings* of the American Institute of Electrical Engineers, 1890, Vol. XVII., No. 11. This paper contains the first curves of the current and e. m. f. of an alternating-current arc. *b.*—Heubach on watt consumption and power factor of an alternating-current arc with different carbons. *Elektrotechnische Zeitschrift,* 1892, page 460. *c.*—Steinmetz, discussion of above papers, *Elektrotechnische Zeitschrift,* 1892, page 567. *d.*—Prof. Ayrton writes in 1891 in the London *Electrician,* page 736: "If the arc be quite steady and only give out the rhythmic hum that accompanies a good arc such as can be obtained with cored carbons of proper quality, the arc appears to act practically as a simple resistance, and M. Joubert's law does not hold. But if the arc be maintained between uncored carbons of poor quality and be hissing, there is considerable difference in phase between the current and the P. D. between the terminals; further the experiments show that the current is very far from being a sine function of the time, although produced by a dynamo, whose e. m. f. normally follows a harmonic law." *e.*—Froelich arrived through his method (*Elektrotechnische Zeitschrift,* page 65, 1887; *ibid,* 1889, page 210; demonstrated at the Frankfort Exposition, 1891), at the result, that the alternating-current arc does not change the phase of current and e. m. f. See *Elektrotchnische Zeitschrift,* 1892, page 568.

It appears therefore that the principal features of the physics of the alternating-current arc were established before Prof. Blondel communicated his paper on "Alternating-Current Arc Curves" to the Chicago Electrical Congress of 1893.

The writer was not aware that these curves were obtained with the oscillograph. He referred to Messrs. Duddell & Marchant's paper, as it contained the first curves of the enclosed alternating-current arc, and this paper was highly commented on by Prof. Ayrton, S. P. Thomas at the Institution of Electrical Engineers, London.

Very few of Prof. Blondel's papers are published in this country or in Germany. The writer was, therefore, not aware of the scope of Mr. Blondel's work. He hopes that by calling attention to the oscillograph, the instrument will find a place in all laboratories and shops and facilitate the study of the many intricate problems of alternating-current work. C. WILER.

CHICAGO, ILL.

## The South Norwalk Municipal Plant.

*To the Editors of Electrical World and Engineer:*

Sirs:—Mr. M. J. Francisco's characteristic article in your issue of Feb. 2, relating to the last report of the South Norwalk municipal electric light plant, has been read by me. I am not surprised to note how he resorts as usual to distortion of figures and perversion of facts, adding or subtracting with the abandon of one hardened to a pernicious habit of long practice, and again attempts to tarnish the splendid reputation that this plant has earned as an acknowledged success and a shining example of the possibilities of municipal ownership.

I deny what he assumes to prove by the methods outlined above,

and deem it unnecessary to point out in detail what he as well as I know are his own misrepresentations. If there is any just person who may know so little as to credit his assertions, I will guarantee that a visit of investigation to this plant will make him its friend, whatever he may have been before.

He deplores the absence of a sinking fund, but note how he covers up the fact that only last year this plant reduced its debt by $2,500 from its profits. Then, again, he adds interest on a part of the investment that is not due yet. To this he adds cost of water, when the plant does not have to buy water. Not satisfied, he adds taxes, when the plant, by operating the fire-alarm system of the city without any charge to the city, makes ample return in lieu of taxes. All this effort to prove that more than $60 per year per arc light for 1.30 a. m. service was paid. He takes no account of the fact that a part of the expense that he tries to saddle onto the cost of the arc lighting belonged to the commercial service which is self-sustaining and profit-bearing.

If the facts are as Mr. Francisco would have them appear, would the Government Statistician, who made a personal investigation of this plant, have made a report not only gratifying to it but most encouraging to the cause of municipal ownership?

Some little time ago the city of South Norwalk by a unanimous vote refused to listen to an offer of a private corporation to buy this plant at a price equal to twice its cost, which I believe is ready to make the same formal offer to-day. It knew what it was about, as it had a corps of accountants, engineers and lawyers investigating the plant for several days previous to taking any decided step. If this plant was a burden to them, would the citizens have voted not to listen to any offer to rid themselves of it at a good price? And would the private corporation unasked have been so anxious to possess it?

Possibly we may learn sometime who is paying Mr. Francisco for the harm he thinks he is doing the cause of municipal ownership. But not questioning his ability as an oracle on the management of central stations, it might be of interest to some people to know something of what used to be his Rutland plant, and how he came to let it slip away. But I will refrain from further questions in this line and only ask if one who could not seem to keep his own private plant from insolvency, is a proper person to contradict the results of a successful municipal plant?

Will not such men as this be more likely to harm the cause they advocate and their masters than the cause of municipal ownership? Are they influencing public opinion in their favor? If so, how is it that municipal light plants have increased in this country alone in the last two years or so from 300 to about 500? Two new ones per week seems to be the present record, and the "fad" will continue so long as private corporations in public service do not properly compensate the people for the valuable franchises that give them life. Municipal ownership is but a remedy for the wrongs that have been heaped upon the public in the past, and it must continue until private corporations created by legislative action realize that the people, their creators, not themselves, are the masters.

SOUTH NORWALK, CONN. A. E. WINCHESTER.

# DIGEST
## OF
## CURRENT ELECTRICAL LITERATURE.

### DYNAMOS. MOTORS AND TRANSFORMERS.

REFERENCES.

*Winding Coils.*—CLAUSSEN.—A communication referring to the article of Loewit, noticed in the Digest, Nov. 17. He shows that the same method which Loewit used for the determination of the diameter of a wire for given dimensions of the spool, can also be applied for the determination of the length of the spool, as in the case of designing a dynamo.—*Elek. Zeit.*, Dec. 13. A translation in abstract of Loewit's paper in *Jour. of Elec.*, Dec.

*General Transformer Diagrams.*—Quite a number of communications by Heubach, Behrend, Grob, Emde, and Ossanna, in which the long discussion in this journal on general transformer and induction motor diagrams is continued and concluded.—*Elek. Zeit.*, Dec. 27, Jan. 24.

*Direct-Current Motors and Synchronous Alternating-Current Motors.*—A clear comparison of these two types of motors, the difference of their action and the reasons to which it is due. It seems to contain nothing new.—*Jour. of Elec.*, Dec.

*Large Alternators.*—Several communications, by Meyer, Schueler, Rohde and the United Electric Company, of Vienna, criticizing some points in the paper of Heyland, noticed in the Digest, Jan. 5, 12. It is claimed that the use of a high saturation of the poles is not new.—*Elek. Zeit.*, Jan. 3.

### LIGHTS AND LIGHTING.

REFERENCES.

*Train Lighting.*—A reprint in full of a very extended topical discussion on the introduction of electric lighting on railway cars, in the Electrotechnical Society, of Berlin; also a long abstract of a paper, by May, read before the Electrotechnical Society, of Frankfurt, on the same subject.—*Elek. Zeit.*, Jan. 3.

*Arc Lamps.*—ALMERT.—A paper, read before the Chicago Elec. Ass'n, on "Arc lamp standardization." It deals mainly with photometric tests of arc lamps and with the different lights tandards in use.—*West. Elec.*, Feb. 2.

### POWER

*Electric Power in Factories.*—PHILIPPI.—A long and well illustrated description of the electric power and lighting installation of the Hartmann Machine Works in Chemnitz, Germany. There are four steam-driven alternators, generating three-phase currents at 500 volts. All the motors in the shops are three-phase induction motors. All the stationary motors are supplied with current at 500 volts, while the movable motors of the cranes, etc., are supplied with three-phase current at 120 volts from transformers, for the sake of safety, on account of the bare conductors. For the lighting of the shops, three-phase currents at 120 volts are used, as the central station of that city also supplies three-phase currents at 120 volts, so that this current may be used as reserve. For the lighting of the office building, direct current at 120 volts is used, which is supplied by a 40-kw motor generator, in combination with a battery of 1150 ampere-hour capacity. There are at present in use 60 motors of together 1700 hp. The installation is said to be highly successful and the following advantages are mentioned. There have been no accidents with the electric motors so far, and the cost of repairs was practically zero. There is a saving in wages, as fewer attendants are required. There is a great saving in fuel, etc. If 5 per cent are assumed for interest on the whole plant, 5 per cent for amortization of the power house and 3.5 per cent for amortization of the other plant, the cost of 1 kw-hour measured at the bus-bars of the primary switchboard, is 1 cent, and measured at the shaft of the machines, 1.37 cents. There is also a considerable saving of floor space.—*Elek. Zeit.*, Jan. 3.

*Refuse Destructors.*—WATSON.—An article on "The disposal of refuse in the twentieth century." A refuse destructor properly designed and constructed is at present the only known means of disposal which satisfies both sanitary and economical requirements. He gives some notes on their proper design. Regarding the most important by-product of the destructor, mainly the waste heat, he says that town refuse varies far more in different towns than does coal in different collieries. "It will, however, be safe to generalize to this extent, that in all districts in the neighborhood of coalfields, from 1 lb. to 1¼ lbs. of steam may be counted upon as available for external use for every pound of refuse burned in an efficient destructor, and that in residential districts remote from cheap coal, from ¾ lb. to 1 lb. of steam may be counted upon with equal certainty." He warns, however, against generalizations of results obtained in special cases. —Lond. *Elec. Rev.*, Jan. 25.

### TRACTION.

*Sag and Strain in Trolley Wires.*—B. HOPKINSON.—A short article in which he calls attention to an ambiguity in Dawson's electric traction pocketbook, in which tables are given for the sag of a trolley wire at different temperatures. From those data, it would follow that the wires so strung would become dangerously tight if the temperature should fall below freezing, and as in practice such wires are al-

most always put up tighter than according to that data, and do not break, there must be a discrepancy. This, the present writer thinks, is due to a neglect of the consideration of the elastic extension of the wire. He develops formulas in which this is included, and gives a short table of data for hard-drawn copper wire 0.4 in. diameter and 120 ft. span. The results are based on a test made by Prof. Ewing. The table shows that if the sag is 6 in. at 60 degs. F., the wire would never in that country (England) be stretched beyond its limit of elasticity. The table also shows that at 170 degs. F. the sag would be only 9 in. A wire hung so that the sag is 12 in. at 50 degs. F. will at 90 degs. F. drop down to 18 in., which is excessive.—Lond. *Elec.*, Jan. 25.

*Electric Traction in Great Britain in 1900.*—A very large table, in the form of a supplement, giving a large amount of information regarding electric railways and tramways in the United Kingdom in 1900. In 1899 there were 42 lines in operation, 28 in process of construction, and 111 projected tramways and railways, making a total of 181. In 1900 there were 62 lines in operation, 31 in progress and 127 projected, giving a total of 220. Concurrently with the rapid development of electric traction there is also a growth of several species of opposition, the chief of which relates to electrolysis, to magnetic disturbances of observatories and to vibration. A matter of serious moment is the vibration and consequent nuisance and injury to property, which is alleged to be set up by the Central London Railway. It is probable that this vibration originates in the use of heavy locomotives, in which the greater part of the weight is unsupported by springs, but, on the contrary, is imposed directly on the axles of the driving wheels. The remedy lies in either using spring-suspended and geared motors on the locomotives, or else in abandoning the use of separate locomotives and distributing the motive power throughout the train.—Lond. *Elec.*, Jan. 25.

*Storage Batteries in Traction Stations.*—BOOTH.—An article in which he shows the advantages that can be obtained in traction stations by means of storage batteries. The engine should be of such power as to perform the mean duty required. The mean load is determined by the number of cars at work and their average speed, "and we will not vary much from 10 to 12 amperes per car for 28-ft. cars in ordinary English practice." From German experience he says that a battery has been found sufficient, if it provides the maximum discharge for one hour. Thus if the maximum current be 300 amperes the battery capacity would be provided to yield a steady 300 amperes for one hour. For small tramway systems the economy will be undoubted if suitable and liberal batteries are provided, but the larger systems do not require batteries, because where load factors of 70 and 80 per cent can be secured, the battery losses must more than outweigh the economy. At the same time, with large load factors, it must not be overlooked that the output of the battery will be comparatively small, as quite a small battery will be competent to "rub off the spokes of the load diagram."—Lond. *Elec. Rev.*, Jan. 25.

*High-Capacity Storage Battery for Automobiles.*—FABRE.—An illustrated description of the Lacroix accumulator. Both plates consist of thin wires, each being formed of two metals. The core of each wire is antimoniate of lead, or any lead alloy not subjected to formation, the diameter of the core being 0.05 to 0.6 mm. Around this core there is a layer of lead in ring form, of about 0.2 mm thickness. For a battery of 120 ampere-hours one electrode consists of 300 such wires of 200-mm length. It is claimed that in this way a battery can be constructed giving 25 ampere-hours per kilogram of total weight, and that the life of this battery is sufficiently long to use it in practice.—*L'Eclairage Elec.*, Jan. 5.

REFERENCES.

*Third-Rail System.*—WASHINGTON.—An illustrated description of the Murphy third-rail system, to be used by the Baltimore & Ohio Railway in Baltimore.—*West. Elec.*, Feb. 2.

*Jungfrau Railway.*—A long illustrated description of the Jungfrau polyphase electric railway, which was described in these columns May 12, 1900, in an article by the constructing engineer.—*Elec. Rev.*, Feb. 2.

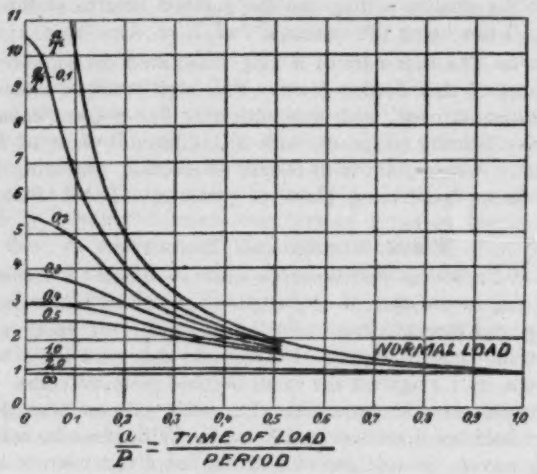
*Aerial Electric Traction.*—ADAMS.—A brief article on electric traction systems which may be used over deep and comparatively narrow gullies or valleys, at large excavations and embankments for engineering works, for the movement of canalboats, etc.—*Cassier's Mag.*, Feb.

## INSTALLATIONS, SYSTEMS AND APPLIANCES.

*Capacity in Alternating-Current Working.*—MORDEY.—The conclusion of his illustrated paper, the first part of which was abstracted in the Digest, Feb. 9. He gives a description of the choking coil which he has used. He remarks that "there is something very disproportionate and anomalous about the two classes of loss in the dielectric—the insignificant losses due to leakage, and the large apparent and actual losses due to capacity and hysteresis. Let me take for illustration a 10,000-volt cable having one-third microfared capacity per mile, and working at 50 periods. Its insulation is, say, 2500 megohms (it may be only a few megohms without affecting the argument). The dielectric has several functions. It acts as a nearly perfect non-conductor. But it does conduct a little. It allows 1-250,000 ampere to pass through it, equals 0.04 watt per mile. Then there is the electrostatic action. * * * The capacity current is 1.05 amperes, the apparent watts 10,500, and the real watts 1296 or 32,400 times the watts lost by conduction. This is an interesting state of things. Both dielectric conduction and dielectric hysteresis waste energy in the same way—by heating the dielectric. We use an insulator which reduces the leakage energy loss to 0.04 watt per mile, but allows another energy loss 32,400 times as great. So far as loss of energy is concerned we should be just as well off, or as badly, with an insulation resistance of $10{,}000/1.05 = 9524$ ohms, instead of 2,500,000,000. The energy spent on our dielectric would be just the same, and I suppose we should have no wattless current at all. I point this out to illustrate an anomaly, not to make a practical suggestion. It may be that no low resistance insulator can be found capable of resisting breakdown under such conditions." The paper is concluded by a description in detail of an alternating-current wattmeter for such tests. In the discussion which followed, Ayrton questioned whether Mordey has sufficiently tested either the cable or the Thomson recording wattmeter, to feel sure that the low power factor he was dealing with was read correctly. Mordey replied that the power factor had been determined with the greatest care.—Lond. *Elec.*, Jan. 25.

MATHER.—A communication referring to Mordey's paper. He suggests measuring dielectric hysteresis loss by putting the dielectric of the cable in series with a suitable choking coil without iron, and arranging matters so that the current through them is approximately in phase with the P. D. of the alternator. An ordinary wattmeter would then measure the power spent in cable and choker with fair accuracy. The watts spent in this ironless choker can be determined by the product of the square of the current and the resistance, and deducted from the wattmeter reading.—Lond. *Elec.*, Jan. 25.

*Calculation of Resistances, Motors, Etc., for Discontinuous Service.*—OELSCHLAEGER.—Resistances, motors, etc., built for continuous operation, are of too large a size when used for frequently interrupted service, as, for instance, in the operation of lifting apparatus. He shows how to calculate a resistance for discontinuous service. The results can, of course, also be applied to motors, generators and transformers. He gives a series of characteristic curves which indicate how many times greater the load can be made for interrupted service, than for continuous service, without surpassing the limit of increase of temperature, allowed for normal load. These curves are




CHARACTERISTIC CURVES.

based upon one constant, the "time constant," which can be found either by calculation or by an experiment. For the exact determination of the kind of discontinuous service the knowledge of the ratio of the time of load and of the period is required, also the absolute value of the time of load. This series of characteristic curves is shown in the adjoining diagram. The ordinates represent the ratio of time, $a$, of load, and the whole period, $P$, this period, $P$, being the sum of the time of load and the time of rest. It is evident that the

ratio $a/P$ must therefore be smaller than unity. It becomes unity for continuous service. The ordinates of the diagram give the ratio of the load with interrupted service and of the load with continuous service, the increase in temperature being the same in both cases. The different curves are plotted for different values of $a/T$, i. e., the ratio of the time, $a$, of load and the "time constant," $T$. This time constant is the only constant that must be known, in order to determine the behavior of a given resistance in a discontinuous service. To calculate this time constant for a certain resistance, it is required to determine the temperature limit which it finally reaches with a continuous load of, $Q$, watts. Let $t$ be the difference of this temperature limit and of the temperature of the surrounding air. If the weight of the resistance in grams is $G$, and the specific heat $s$, ($t$ and $s$ being given in the same thermometric scale), then the time constant $T$ in seconds is the product, $4.16\ G\ s\ t$, divided by $Q$. As the method appears to be of practical value, a numerical example may be given; say, a resistance can stand continuously 1000 watts, its time constant was bound to be 150 seconds equals 2.5 minutes. The time of load in the regularly discontinuous service may be $a$=0.5 minute, and the time of rest equals 0.5 minute, therefore the period $P = 1$ minute, so that $a/P = 0.5$ and $a/T = 0.2$. For the curve, $a/T = 0.2$ in the diagram, the abscissas 0.5 corresponds to the ordinate, 1.85; i. e., if in such a discontinuous service of 0.5 minute with 0.5 minute rest, that resistance is loaded with 1850 watts, it does not become warmer than if it is loaded in continuous service with 1000 watts. It is evident that for $a/P = 1$, the service is continuous, and therefore all the curves must have the ordinate unity for this abscissa, that is, for continuous service. It will also be seen that the load in discontinuous service may be chosen the greater, the smaller the time of load, compared with the period, and compared with the time constant.—*Elek. Zeit.*, Dec. 20.

*Calculation of Resistances for Dissipating Energy.*—Girault.—A short article in which he develops the formulas for accurately calculating a resistance for dissipating energy under the following assumptions. The resistance material is to be in the form of a metallic band of constant thickness, but different widths, the length of which is varied by cutting out parts of it for regulation. It is for constant potential circuits and is supposed to be in series with a fixed constant resistance. The basis of the calculation is that the density of the current should remain constant in the variable resistance. This gives the maximum degree of utilization of the material and of the resistance. The formulas are too complicated to give here. He draws the following conclusions. For the same value of the specific cooling surface the volume of metal is independent of the resistivity of the metal used, depending only on the specific cooling surface. The widths of the bands are directly proportional, and the lengths inversely proportional to the square root of the resistivity, for the same value of the total resistance. The less resisting metals therefore correspond to the smaller widths and the greatest lengths of the resisting band, all else being the same.—*L'Ind. Elec.*, Dec. 10.

*Southport.*—The first part of a long illustrated description of the electric plant of this British town. The high-pressure alternating-current system is used, with sub-stations. The present capacity is 1150 kw for lighting purposes, with an additional plant of 600 kw for traction. A new plant is in course of erection, providing accommodation for a generating plant of 3000 kw.—Lond. *Elec. Rev.*, Jan. 25.

### Wires, Wiring and Conduits.

*Saving of Copper in Transmission Lines.*—Besso.—A communication referring to the system of Bedell of combined transmission of alternating and direct current, and to the article of Spielmann abstracted in the Digest, Dec. 29. He remarks that with the scheme of Bedell, the e. m. f.'s against the earth become quite different. In the most favorable case the maximum alternating-current e. m. f. is increased by half the direct-current e. m. f. With the new maximum e. m. f., however, the sole use of nothing but direct current is more economical. The system of Bedell and a similar one of Troucone, cannot be more economical than pure direct current for the same maximum e. m. f. between a conductor and earth.—*Elek. Zeit.*, Dec. 20.

### References.

*Cable Breakdowns.*—Hanappe.—A long mathematical paper, referring to the paper by Kapp, abstracted in the Digest, Jan. 20, 1900. By a graphical method he shows that a very simple calculation may be used for the determination of the maximum tension between the outer conductor and the earth, and that the graphical method may be generalized for plotting the tension curves. He considers a circuit with self-induction and capacity in two particular cases. The first case deals with constant e. m. f. and self-induction and with variable capacity. The second case relates to the secondary of a transformer in short circuit with a constant capacity, the primary being supplied under constant pressure. He applies the results obtained in these cases to a study of the capacity effects dealt with by Kapp.—*L'Eclairage Elec.*, Dec. 29.

*Inductance of Long Transmission Lines.*—*Sartori.*—A mathematical paper. He studied the transmission of power by three-phase currents over a distance of 24 miles. He gives the formulas obtained by him for calculating the inductance of such lines.—*L'Elettricista*, March, 1900; abstracted in *L'Eclairage Elec.*, Dec. 29.

*Cables.*—A brief illustrated description of different kinds of electric cables used in the British Navy.—Lond. *Elec. Rev.*, Jan. 25.

### Electro-Physics and Magnetism.

*Stratified Discharge.*—Riecke.—He thinks that the explanation of the stratified discharge must not be sought in the analogy of any wave motion like Kundt's dust figures, but rather in the analogy of a fluid jet which periodically expands and contracts as its distance from the orifice increases. Cathode rays, proceeding as they do by projection from the cathode, may behave substantially like a jet, as they leave the cathode with a definite initial velocity. He attempts a mathematical investigation from which it follows that the curve of velocities becomes a periodic one, and consists of an exponential curve and a sine curve of increasing amplitude superimposed. When there is no viscosity, the periodicity disappears. The same thing happens if the initial velocity is very small.—*Phys. Zeit.*, Jan. 12; abstracted in Lond. *Elec.*, Jan. 25.

*Cathode Ray Tubes.*—Rollins.—A continuation of his long illustrated serial. He describes a method by which he has found that cathodes lost in weight, some losing more than others, with the same amount of electricity. He also describes a cathode of radio-active substance and a "seehear" containing two principles which are new in stethoscopes, one a sound chamber, the other a fluorescent screen in connection with a sound chamber. There is certainly an advantage in hearing the sounds in the chest of a patient while the organs are under inspection by Röntgen rays.—*Elec. Rev.*, Feb. 2.

*Magnetic Hysteresis.*—Krogh and Rikli.—An article illustrated by diagrams, on "Magnetic inertia," i. e., that property of soft iron by which its magnetic flux is unable to follow immediately too rapid variations of the e. m. f. This property causes an increase of the hysteresis loop for the same maximum induction with increasing frequency, also a lag of the maximum induction behind the maximum of m. m. f., also a decrease of the permeability. They have investigated the influence of the frequency upon the magnetic inertia with constant maximum induction. The frequencies used by them varied between 10 and 100 p. p. s. The results are given in diagrams. Among other things they found that the hysteresis loss depends upon the wave form, it is greater for pointed e. m. f. waves than for flat e. m. f. curves. They also found a distinct decrease of the permeability with increasing frequency.—*Elek. Zeit.*, Dec. 27.

*Torsional Magnetostriction.*—Barus.—A paper on "Apparent hysteresis in torsional magnetostriction and its relation to viscosity." He describes a series of phenomena bearing on the permanence of torsional magnetostriction in iron and nickel magnetized by circular and by longitudinal fields. The phenomena are evoked by purely magnetic action. They are obtained by twisting the wire alternately back and forth over a definite angle within the elastic limits and examining the change of rigidity produced by circular or by longitudinal magnetization immediately after each new twist and after several repetitions of the magnetization. The first magnetization succeeding any twist, operates on the magnetic configurations surviving from the preceding twist and magnetizations; the remaining magnetizations (current alternately made and broken) for the same twist operate on the new configurations produced by the twist in question and the first magnetization applied to it. The results are very different, the former are viscous (temporary), the latter elastic (permanent) in character. He uses Maxwell's theory of viscosity, in which any deformation due to molecular instability is a viscous deformation. When the breakdown is gradual in character, which it must be if dependent on temporary local intensities in the distribution of heat motion, the deformation will be gradual as actually observed in ordinary viscous phenomena. If, however, the breakdown is instantaneous, due, for instance, to the molecular shake-up ac-

companying magnetization or its withdrawal, then viscosity is instantaneously a minimum, the deformation sudden, and the phenomenon "static."—*Am. Jour. of Sc.*, Feb.

REFERENCES.

*Effective Value of Alternating Waves.*—BRISSE.—A mathematical article illustrated by diagram. The effective value of an alternating wave is in close relation with the time integral of the square of the instantaneous values. He describes a graphical method for calculating this integral and determining the relation between the effective value and the maximum instantaneous value, if the wave form is given graphically. The integral is represented by a volume. He applies his method to the following cases: Sinusoidal currents, pulsating currents, a wave form represented by a series of teeth.—*L'Elclairage Elec.*, Dec. 29.

*Electric Oscillations.*—FLEMING.—A reprint in full, with illustrations, of the first of his series of Cantor lectures on "Electrical oscillations and electrical waves."—Lond. *Elec.*, Jan. 25.

## ELECTRO-CHEMISTRY AND BATTERIES.

*Potassium Chromate in the Electrolysis of Alkalies.*—MUELLER.—Not long ago there appeared an article in which the advantages were pointed out of adding a small amount of potassium chromate to the alkalies during their electrolysis. It was shown that the addition of this salt was very beneficial. In the present article the nature of the action of this salt is discussed at some length, chiefly from a theoretical standpoint, and the results of experiments are given, which he believes suffice to show that the action of the chromium salt is somewhat like that of a diaphragm, and that its catalytic action is questionable. He believes that electrolyses, with the chromium salt is one of the most ideal diaphragm processes that could be imagined.—*Zeit. f. Elektrochemie*, Jan. 3.

*Carbides, Borides and Silicides.*—HUTTON.—An article in which he says that the discovery of the production of calcium carbide and carborundum in the electric furnace, followed by their rapid technical application, has to a very great extent been the cause of withholding attention from some of the other products of a similar kind, which have been studied especially by Moissan and seem destined to become of industrial application in future. The metallic carbides are decomposed by water, whilst those of the metalloids are not. The carbides of tungsten, vanadium chromium and iron form an intermediate group. Carbides of the alkalies and alkaline earths give acetylene. Carbides of aluminum and beryllium give pure methane. Manganese carbides react with water, giving equal volumes of hydrogen and methane. The carbides of the rare earths, cerium, etc., give mixtures of acetylene, methane and ethylene. The carbides possess another important property in being most powerful metallurgical reducing agents. Reference is made to the application of carbides for the production of artificial graphite in the electric furnace. The silicides and borides which are prepared in the electric furnace are amongst the most stable substances known. They have the valuable property of great hardness, and consequently find application in cutting, grinding and polishing. Silicium carbides or carborundum is now made in large quantities. The borides are also very stable compounds. Even those of the alkaline earths, such as calcium boride, are not attacked by water.—*The Electrochem. and Met.*, Jan.

REFERENCES.

*Transference Numbers.*—NOYES.—A long paper in which he describes a modification of the usual method of determining transference numbers, and gives an account of an investigation of the influence of the concentration on their values in the case of some tri-ionic salts.—*Phys. Rev.*, Jan.

*Estimating Free Alkalies.*—VON HUBER.—A paper describing a method for estimating the percentage of free alkalies, when hypochlorites, chlorates and chromates are present.—*Zeit. f. Elektrochemie*, Jan. 3.

*Electro-Chemistry in 1900.*—KRUEGER.—The first part of an article giving brief descriptions of new inventions and improvements in electro-chemistry in 1900. This part deals with the theory of electrochemistry.—*Elektrochem. Zeit.*, Jan.

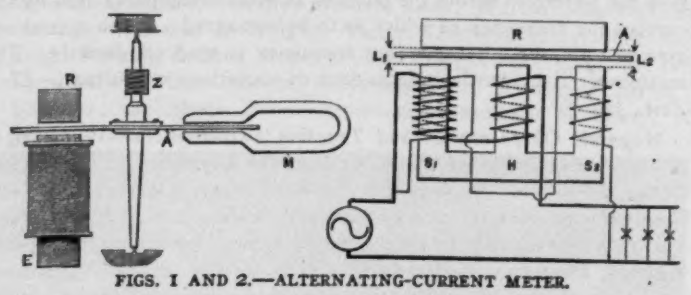
*Progress in Electro-Chemistry.*—The first part of a review of "some recent progress in electro-chemistry." Improvements or new processes are briefly described. This part deals with the electric methods of manufacturing aluminum, zinc, copper, iron, gold, chlorates and hypochlorites.—*The Electrochem. and Met.*, Jan.

*Electrolytic Preparation of Phosphorus.*—A brief description of the Dile appartus, recently patented in Germany. It is claimed to work continuously and to require no other manipulation than that of introducing a fresh quantity of material after each batch is exhausted. Phosphoric acid mixed with coke or charcoal is used.—*Sc. Amer.*, Feb. 2.

*Solutions in Liquid Ammonia.*—LEGRAND.—A long illustrated account of an experimental investigation of the electric conductivity of certain salts and of sodium, dissolved in liquid ammonia.—*L'Eclairage Elec.*, Jan. 19.

## UNITS. MEASUREMENTS AND INSTRUMENTS.

*Alternating-Current Meter.*—An illustrated description of a watt-hour meter for alternating-current lighting circuits of the General Electric Company, of Berlin. The meter is of small size, the diameter being less than 9 in., and its weight 11 lbs. Its price is low, and it is claimed that by its introduction the meter rent paid by consumers will be reduced to one-half its present amount. It is illustrated in the adjoining diagrams. There is a revolving disk, *A*, subjected to the action of two alternating magnetic fields differing in phase, which, owing to their special disposition, impress a comparatively large driving force on the disk. The pressure bobbins $S_1$ and $S_2$, as well as the main current bobbin, *H*, are placed at one side of the disk, the three cores of the bobbins being connected to a single yoke, *E*, and the magnetic circuit being completed by a single armature, *R*. The two shunt bobbins, $S_1$ $S_2$ impart alone, that is, without the main current, a fairly strong torque to the disk, either when the air spaces, $L_1$ $L_2$ of the two pressure cores are unequal, or when the magnetic force of the two pressure bobbins is different. This torque would cause the meter to run when no current was flowing, and it must be reduced to an amount which is just sufficient to overcome the friction of the ap-

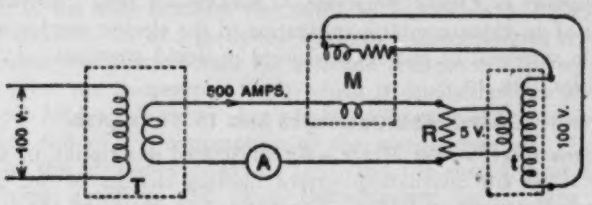



FIGS. 1 AND 2.—ALTERNATING-CURRENT METER.

paratus. This can be done by varying the number of turns or the air space. In the present instrument the latter is made adjustable. If the main current is now turned on a mutual action takes place between the magnetic flux of the main current and the eddy currents generated in the disk by the shunt bobbins on the one hand and between the magnetic flux of the shunt bobbins and the eddy currents generated by the main current bobbin, on the other hand. The result is that the disk, *A*, is set in rotation. The field of the main current bobbin acts upon the fields of the shunt bobbins so as to reduce one and increase the other. The core of one of these bobbins would thus reach the saturation point much sooner than that of the other, and the proportionality would be disturbed. To prevent this, a part of the main current circuit is wound about one of the shunt cores, to compensate for this inequality in the field. If the same effect were produced by winding different numbers of turns on the two shunt bobbins, then, as stated above, the meter would run when the main current was not turned on, which is an insuperable objection to this method of compensation. The magnet, *M*, acts as a brake to the disk. The rotation of the disk is transmitted to a counting mechanism by worm gear.—*Zeit. f. Beleucht*, Jan. 10; Lond. *Elec. Rev.*, Jan. 25.

*Obtaining Alternating Currents and Voltages in the Same Phase for Fictitious Loads.*—CAMPBELL.—When testing instruments for the measurement of large amounts of electrical power or energy, it is usually desirable to do so by means of fictitious loads, *i. e.*, by applying to the instrument under test current and e. m. f. representing the required load, but not actually producing the load. To obtain a fictitious non-inductive load with alternating currents the current and e. m. f. must be in phase with each other, although they do not belong to the same part of the circuit. He has found the following arrangement convenient for this purpose. Suppose the fictitious load required is 500 amperes at 100 volts. In the adjoining figure, *T* is a transformer with its primary on 100 volts, its secondary giving out 500 amperes at 5 volts or 6 volts. Connected in series on the second-

ary circuit are the series coil of the instrument under test, an ammeter *A* and a non-inductive resistance *R*, to take 500 amperes at about 5 volts. Across suitable points of this resistance is connected the low-pressure coil of a closed iron-circuit transformer *t*, of ratio 1:20, such as is commonly used for transforming, say, 1 kilowatt




ALTERNATING CURRENTS AND VOLTAGES IN SAME PHASE.

from 100 volts to 2000 volts. The high-pressure coil of this transformer furnishes the 100 volts required for the shunt coil of the instrument. "It will be found that the e. m. f. is practically in phase with the current of 500 amperes."—Lond. *Elec.*, Jan. 25.

*Determining the Frequency.*—KEMPF-HARTMANN.—A long, illustrated description of an instrument of Hartmann & Braun for measuring the frequency. It is based upon the principle of the electromagnetically excited tuning fork; it begins to vibrate when the frequency to which it is tuned corresponds to the frequency of the alternating current supplied to the coil of the electromagnet, which attracts one arm of the tuning fork. Instead of a tuning fork he uses a reed of steel. In the actual instrument 32 steel reeds, corresponding to frequencies between 79 and 110, are arranged erect in a circle, the upper ends being free and capable of vibrating. By turning a button they can be moved before the poles of an electromagnet excited by the current the frequency of which is to be measured. When a reed begins to tune, the corresponding frequency is read off directly. The instrument is evidently independent of variations of voltage.—*Elek. Zeit.*, Jan. 3.

*Magnetic Observatories and Traction Disturbances.*—WEDMORE.—A communication in which he criticizes the arguments of Glazebrook (Digest, Feb. 2). He says that the stray currents observed are evidently due to some traction system or systems, while all such systems are at a considerable distance from Kew. According to Edler's formula, there should already be a considerable vertical disturbance at Kew, and this should be augmented by the presence of the bonded rail in the immediate neighborhood.—Lond. *Elec.*, Jan. 18.

REFERENCES.

*Slide Wire Resistance.*—EDELMANN.—An illustrated description of a slide wire resistance devised by him and consisting of a series of resistance coils, with five levers for making contact with five circular contact pieces. It can be used so that the whole length of the resistance corresponds to 1 or 10 or 100 or 1000 or 10,000 ohms.—*Elek. Zeit.*, Dec. 20.

*High Tension Electrometer.*—SCHWARTZ.—A communication referring to the article of Baeumler (Digest, Dec. 29), and giving some results of tests of the Ebert-Hoffmann high tension electrometer.—*Elek. Zeit.*, Dec. 20.

## TELEGRAPHY, TELEPHONY AND SIGNALS.

REFERENCES.

*Telephone Receiver for Space Telegraphy.*—POPOFF and DUCRETET.—A description of a receiver which dispenses with a relay and a decohering device, the messages being read by means of a telephone receiver. The coherer is filled with grains of hard carbon or other substance. The air wire need only be a couple of feet long. A good earth connection is required. The apparatus is said to be exceedingly sensitive.—*Comptes Rendus*, Dec. 31; abstracted with an illustration in Lond. *Elec.*, Jan. 25.

*Multiple Switchboard.*—An illustrated description of the multiple switchboard of Mix & Genest for telephone exchanges of small and medium size.—*Elek. Zeit.*, Dec. 20.

*Long-Distance Cable Telegraphy.*—BREISIG.—A mathematical paper in which he describes a method for determining the influence of the transmitting and receiving apparatus at the ends of a long cable, upon the telegraphic signals.—*Elec. Zeit.*, Dec. 13.

*Insulated Telephone Wires.*—A reply to the criticism of West (Digest, Dec. 29), by the company which makes the Hackethal telephone wire (Digest, Nov. 24).—*Elek. Zeit.*, Dec. 13.

## MISCELLANEOUS.

REFERENCES.

*Paris Exposition.*—MONTPELLIER.—An illustrated description of galvanometers exhibited by Hartmann & Braun.—*L'Elec.*, Jan. 19.

ARMAGNAT.—An illustrated description of various induction coils and interrupters which were exhibited.—*L'Eclairage Elec.*, Jan. 5.

REYVAL.—An illustrated description of arc lamps exhibited by Thury and by Koerting & Mathiessen.—*L'Eclairage Elec.*, Jan. 5.

REYVAL.—Illustrated descriptions of a 1200-kilovolt ampere three-phase, delta-wound alternator of Ganz & Company, the voltage being 2200, the power factor 0.7, the number of poles 48, the speed 125 r. p. m., the frequency 50; and of a similar machine of the same firm, differing from the former only in the number of poles and frequency, which are 40 and 42, respectively.—*L'Eclairage Elec.*, Jan. 12.

ARMAGNAT.—An illustrated description of some measuring instruments in the Hungarion, Swiss and Italian sections.—*L'Eclairage Elec.*, Jan. 19.

REYVAL.—An illustrated description in detail of the installation for electric lighting of the Eiffel Tower.—*L'Eclairage Elec.*, Jan. 19.

HORNER.—A well-illustrated description of different electric cranes exhibited.—*Cassier's Mag.*, Feb.

RICHARDS.—A Franklin Institute paper on aluminum exhibits.—*Jour. Frank. Inst.*, Feb.

## New Books.

AN INTRODUCTION TO MODERN SCIENTIFIC CHEMISTRY. By Dr. Lassar-Cohn. Translated by M. M. Patteson-Muir, M. A. New York: D. Van Nostrand Company. 348 pages, 58 illustrations. Price, $2.00.

This book does not contain, as some might think from its title, an exposition of the modern theories of solution, electrolysis, etc., but is devoted to the theories that were known as "The new chemistry" a quarter of a century ago. That is, the ordinary chemistry of today. The book is very elementary in character and evidently intended for beginners, who will find it within the limitations above pointed out, interesting and instructive.

NATIONAL ELECTRIC LIGHT ASSOCIATION. Report of Twenty-third Convention. By order of the Executive Committee. The James Kempster Printing Company. 455 pages, 10 illustrations, 43 diagrams. Cloth.

This is an excellent addition to the long series of volumes now issued by the Association during its useful career, and embodies many important papers and discussions. The papers include those of President Cahoon on uniform accounting; W. L. Abbott on central station economics, H. J. Frith on utilization of exhaust, Prof. Robb on series enclosed alternating arcs, H. L. Doherty on rates, H. G. Reist on alternating current generators, E. A. Sperry on automobile revenue, R. S. Feicht on combination plants. There are also valuable reports on the photometric values of arc lamps by Profs. Matthews and Goldsborough, and on grounded circuits by Capt. Brophy. The volume has been put through the press in excellent shape by Miss Billings, the assistant secretary. It has as a frontispiece a portrait of Past President Carnes, and as an appendix the Institute or joint report on standardization of electrical apparatus.

THE COAL AND METAL MINERS' POCKETBOOK. Principles, Rules and Tables. Sixth edition, revised and enlarged. Scranton: The Colliery Engineer Company. 637 pages, illustrated.

The first thing that one notices in examining this book is that there is not given, on the title page or elsewhere, the name of the author, editor or compiler of the contents of the volume. This, however, should not be taken as evidence that those responsible for the work were ashamed, or had reason to be ashamed of the book, for, as a whole, it compares well with the average pocketbook. There are, besides the usual tables of logarithms, etc., many useful articles which, when extracted from original papers, are credited to their respective authors.

A mining engineer in the course of his regular professional work finds use for knowledge on a wide variety of subjects, and this is kept in view in the make-up of the book. For example, no up-to-date mining engineer can get along without some knowledge of electric machinery, and the book devotes 33 pages to electrical subjects.

A good part of the book is devoted to mechanical engineering, and there are notes on a variety of things that may prove useful at times, such as the treatment of injured persons. The greater part of the book is, as it should be, devoted to mining engineering proper—that is, prospecting, working of mines, mining machinery, etc.

## Directory of Electrical Societies, Etc.

AMERICAN STREET RAILWAY ASSOCIATION. Next meeting, New York, Oct. 17-20, 1901.

ASSOCIATION OF THE EDISON ILLUMINATING COMPANIES. Next meeting, Sept. 10, 1901.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Next meeting, Niagara Falls, N. Y., September, 1901.

NATIONAL ELECTRIC LIGHT ASSOCIATION. Next meeting, New York, 1901.

NEW YORK STATE STREET RAILWAY ASSOCIATION. Next meeting, Rochester, N. Y., September, 1901.

NORTHWESTERN ELECTRICAL ASSOCIATION. Next meeting, Sheboygan, Wis., last week in June, 1901.

OHIO ELECTRIC LIGHT ASSOCIATION. Next meeting, Put-in-Bay, Ohio.

PENNSYLVANIA STATE STREET RAILWAY ASSOCIATION. Next meeting, York, Pa., Sept. 4, 1901.

SOUTHWESTERN GAS, ELECTRIC & STREET RAILWAY ASSOCIATION. Next meeting, Houston, Tex., May, 1901.

## The Automobile Show at Philadelphia.

It has become quite the fashion for each large city to have an automobile show, and indeed the fashion is already more or less of a nuisance to the manufacturers, for not even the largest of them can stand such a constant strain on their resources. The tendency is, therefore, to patronize only the best shows in a few of the largest centers of population, and even there to leave the matter to local agents. At the show in Philadelphia last week, evidences of the attitude of indifference of manufacturers toward shows in general were seen, and under such circumstances, the Pennsylvania Automobile Club is to be congratulated upon the result of its maiden effort. The list of exhibitors numbered 66, and it is said that over 300 vehicles were grouped within the building.

For the purposes of the show, which lasted the whole week with afternoon and evening sessions, the Second Regiment Armory Building was taken—a big, ugly stone barn of a place, well out from the City Hall, but by means of bunting and decoration it was made quite attractive interiorly. The now familiar plan was adopted of a central exposition space with a surrounding wide track, an outer pocket for track vehicles, and a fringe of miscellaneous exhibitors on the outer edge of the track. To such a plan Madison Square Garden lends itself admirably, but the armory served very well, except that the 18-ft. track being short and almost circular, caused the wheels to bind a good deal and rather took it out of the tires. Access to the exhibit space in the middle was obtained by means of a four-way footbridge crossing over the track at a safe altitude. One serious objection to the armory on the part of visitors was the fact that there was no sitting accommodation, while others spending hours there complained of the absence of a refreshment bar. On the other hand, outside lay one of the finest asphalted avenues in Philadelphia, giving a splendid opportunity for a straightaway spin with a prospective customer.

There were practically only four electric automobile exhibitors, and only two of these made any serious attempt at an exhibit, the Electric Vehicle Company and the Woods Motor Vehicle Company, both of whom had fine displays and attracted a considerable amount of attention from the visitors, of whom there were large crowds every evening. There were also many callers in the afternoon of those who meant business, as a large part of the evening being given over to track contests of one kind and another, it was hardly possible to discuss such matters seriously at the evening sessions. In general, the exhibits may be noted as follows: Locomobiles, by the Locomobile Company of America; Mobile, Mobile Company of America; Columbia electric, Columbia gasoline, Pennsylvania Electric Vehicle Company; Foster steam (Foster Automobile Company), Orient motor cycle, Orient carriage, John Wanamaker; De Dion Bouton, Marlboro, Century, Maurice Loeb; Winton, Reading steam carriage, Wharton & Wright; Victor, Overman Automobile Company; Fanning electric, Manufacturers' Supplies Company; the Wall, R. C. Wall Manufacturing Company; the Schwarz, Charles L. Schwarz; the Skene, Skene American Automobile Company; National electric automobile, Boston automobile, the gasmobile, Motor Carriage Company; Thornycroft, Thoryncroft Steam Wagon Company; electric ambulance, Fulton & Walker; Union motor truck, Union Motor Truck Company; Woods electric, Woods Motor Vehicle Company; Grout Bros.' automobile, Grout Bros.; Standard, Standard Motor Vehicle Company. The sundries and accessories were: Sundries, R. C. Wall & Co.; lamps (Gray & Davies), bells (Bevin Bell Company), pumps (Gleason-Peters Pump Company), Maurice Loeb; lamps, Rose Manufacturing Company: bells, Liberty Bell Company; tires, Diamond Rubber Company; tires, Consolidated Tire Company; Glasses, Rothchild & Co.; motors and running gears, Motor Vehicle Power Company; engines (gasoline), Philadelphia Gas & Gasoline Engine Company; tires, Pennsylvania Rubber Com-

FIG. 1.—GENERAL VIEW PHILADELPHIA'S FIRST AUTOMOBILE SHOW.

pany; Philadelphia automobile station, Hinchman & Hawkins; Motsinger dynamo sparker, Motor Carriage Company; boilers and tubing, Janney & Steinmetz; tires, New York Belting & Packing Company; motors, Palmer Motor Company; electric charging, Diamond Electric Company; tires (Goodyear), Davie & Co.; tires and automobile coats, Delaware Rubber Company; mechanical engineer and repairs, William F. Rudolph; batteries and dynamos, Dow Portable Electric Assistant Company; graphite, Dixon Crucible Company; automobile trimmings, Keyser & Rogers; tires, Hartford Rubber Works; automobile robes, Jensen & Grossman; lubricants, Columbia Lubricants Company; tubing, A. L. Smith & Co.; lamps, R. E. Dietz & Co.

The exhibit of the Electric Vehicle Company occupied a large triangular space tastefully draped and decorated, and surrounded at night by lamps with large shades in automobile reds. The exhibit included an electric delivery wagon, a surrey, a cabriolet, a runabout, a Victoria, a phaeton and a new type hansom cab. On the track there was a Mark VIII. gasoline runabout, which drew considerable attention, and Mr. Entz and others took frequent spins in the electrics. A noteworthy point was that in the literature handed out, the miles of radius per charge of the vehicle were all marked up from 25 and 30 miles to 40, the batteries supplied now being able to give this increase of distance.

The Woods Motor Vehicle Company had so large an exhibit two spaces were necessary, one within the central space and one outside. The exhibit was in the competent hands of Mr. E. W. Curtis, Jr., and included an extension brougham, brougham cab, hansom cab, top road wagon, game trap (new), a Queen Victoria (new), a 12-passenger wagonette, a "Germantown" (new), a Victoria, a Stanhope and a runabout—all electric. The Queen Victoria is a very handsome and stately type of vehicle, as shown in the accompanying cut. It weighs about 2600 lbs., has two 2½-hp motors, and 40 cells of battery, and has a radius of 35 miles. It may be added, that at the recent bicycle show in Philadelphia under the auspices of the Philadelphia Board of Trade, Mrs. Curtis, with the Woods stanhope carrying its rumble, took a first prize silver loving cup in the floral parade, the vehicle being decked with smilax and carnations.

The exhibit of the De Dion-Bouton Motorette Company, of Brooklyn, included quadricycles and tricycles, etc. The New York type, a two-passenger vehicle, weighs only 450 lbs. The Brooklyn type, weighing 750 lbs., with a capacity for three passengers, came in for much praise, and was kept continuously on the track. A skeleton carriage showed the mechanical construction used by the De Dion-

FIG. 2.—NEW TYPE ELECTRIC AUTOMOBILE "QUEEN VICTORIA."

Bouton Company, was always surrounded by a circle of spectators listening to the explanations of those in charge of the exhibit. The American type quad for two passengers was also much appreciated.

The show was remarkably brilliant at night with electric light signs. Outside, the makers of the "Neverout" oil lamp had cleverly taken large models and put arc lamps within them. The finest interior display was that of the local Diamond Electric Light Company, which had run in its circuits, and which, in addition to some fine incandescent lighting signs and displays, had several charging outfits, and a General Electric "Electrant." One outfit, under the management of Mr. C. A. Bragg, was a Westinghouse 5-kw rotary, on 100-110 two-phase, and delivering direct with a range of from 90 to 150 volts, charging two vehicles at a time. This is the first of these Westinghouse equipments to be shown. In addition there was a

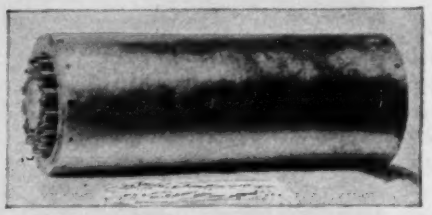
FIG. 3.—VIEW OF TRACK AND ELECTRIC VEHICLE COMPANY'S EXHIBIT.

Wagner single-phase 5-hp motor generator outfit, and a Wagner single-phase motor belted to a small General Electric generator.

The officers of the Automobile Club, which is to be congratulated on the success of its show, are Dr. F. L. Sweany, president; Julian Haugwitz, first vice-president; C. S. King, second vice-president; H. J. Johnson, secretary; W. H. Hinchman, treasurer; R. P. McCurdy, captain; J. K. Wharton and G. E. Gossler, lieutenants; G. E. Gossler, C. L. Klauder, S. R. Weaver, Maurice Loeb and W. F. Rudolph, board of governors.

## Muffler for Gas Automobiles.

The device illustrated herewith is designed to eliminate the noise of exhaust of hydrocarbon motors used on automobides. It is constructed of aluminum and asbestos, both materials being capable of taking care of vibrations resulting from the exhaust. The exhaust is cushioned upon itself, and it is then expanded twice in the small mufflers and three times in the large mufflers. Between each expansion apparatus is placed to change the gas to a stream, and upon its final expansion into the atmosphere it is still further changed in its nature to a practically steady stream. Various sizes of these mufflers are now in practical operation, and it is stated that the results are very satisfactory, the noise of expansion being very greatly reduced.



MUFFLER FOR GAS AUTOMOBILES,

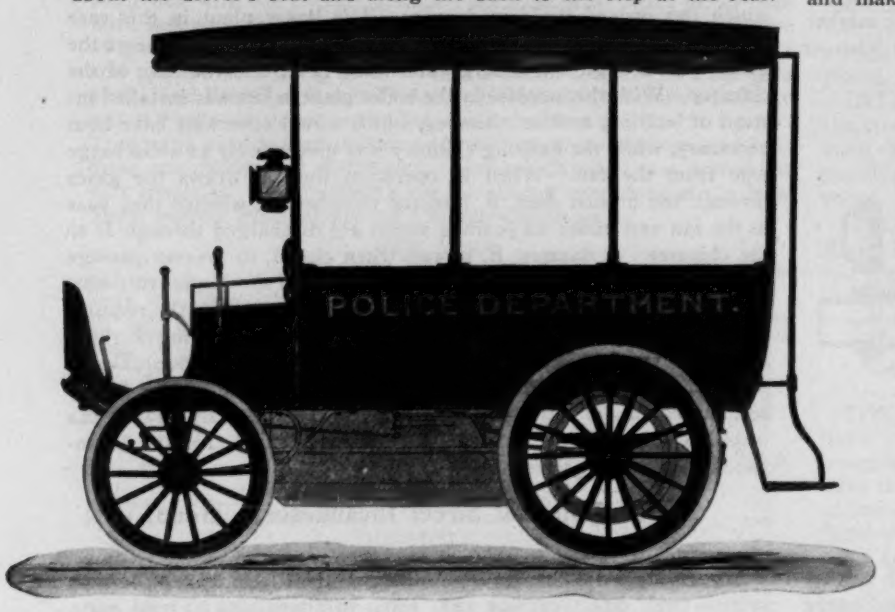
This muffler is manufactured by the Loomis Automobile Company, Westfield, Mass., and can be supplied for any size of exhaust pipe. They are readily attachable, being simply screwed on.

## An Electric Police Patrol Automobile.

The electric patrol wagon, for which the Hartford, Conn., Police Commissioners have signed a contract with the Electric Vehicle Company, has several novel features which have never been adopted in horse-drawn conveyances of this kind. In compartments under the driver's seat will be kept medical and surgical appliances necessary in emergencies, and within the wagon there will be two stretchers. Thus the vehicle can, in cases of emergency, be made to serve the purpose of an ambulance. The tires will be of heavy rubber, permitting the removal of an injured person or a patient without

jolting. Another feature is the manner in which the two seats, running the entire length on the inside, are to be constructed. These seats can be dropped against the sides at will, leaving the inside space entirely free. Thus the carrying capacity of the vehicle can be largely increased. The body of the wagon is modeled after standard horse patrol wagons in New York, and in construction is similar except that the parts supporting the weight of the battery will be heavier. A charging station will be placed in the Police Headquarters station. Extra sets of batteries will be provided, and exhausted batteries can be charged while one set is in use. In this manner the wagon will be constantly supplied with power, the change from an exhausted to a fresh set of batteries requiring only a few minutes.

Wire screens will be provided for the sides and across the front, and upon these screens will be stretched curtains which can be lowered or raised at will. An electric light fixed on a flexible cord can be removed about the wagon. The woodwork of the body of the vehicle will be of white pine, coloring, finish and lettering being left to the Police Commissioners. Heavy brass railings will be provided about the driver's seat and along the back to the step at the rear.




POLICE PATROL AUTOMOBILE.

The wagon will have a capacity of 25 miles on one charge of the batteries and a speed of 11 miles per hour. It is to cost $3000, and to be ready for service in three months.

## New Type of Combination Trolley Car for Brooklyn, N. Y.

Thanks to the efforts and ingenuity of Mr. Eugene Chamberlain, superintendent of equipment, a new type of combination trolley car for summer and winter use has been introduced on the lines of the Brooklyn Heights Railroad, much to the pleasure and satisfaction of the patrons of that system.

The change from winter to summer style is effected by removing the windows, leaving the sides of the car practically entirely open. The windows, each made of one large piece of plate glass, cannot be lowered when in place, but are held firmly to the window posts by iron strips on the outside, the sash being rubber lined to prevent rattling. These strips are secured by three set screws, which pass through the posts from the inside. To remove the windows, therefore, all that is necessary is to take out these three screws from each post, remove the iron strips from the outside, and take the sash out; after which the iron strips are replaced. This operation can be performed in about 40 minutes for each car. The length of the car over bumpers is 37 ft., ¾ in., and the body over corner posts, 28 ft.; the platforms are 4 ft. 7 in. The width over all at grip rails is 8 ft. 1½ in.; at sills 7 ft., and at steps 7 ft. 4 in. From the head of the rail to the top of the trolley board is 11 ft. 5 in., and the height of the car from sill to trolley board is 9 ft. 1 in. The distance between the bolster centers is 18 ft. 11 in. The window openings are 40 in. by 31 in. The curtains, which remain in place for both summer and winter use, are fitted with patent fasteners, and run in diagonal slots in the side posts, which slope outward from the top down. At the bottom these slots reach almost to the outer edge of the window sill, and a flap

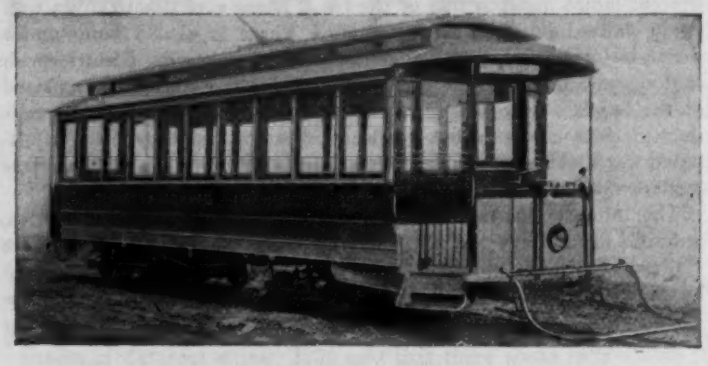


FIG. 1.—COMBINATION CAR.

about 4 in. wide is provided, which extends completely over the sill and makes an efficient watershed. This gives the car a great advantage over the ordinary type of open car, as it is as dry in rainy weather as a closed car would be. There can be no drifting in of the rain on the passengers or empty seats.

The seats are of a peculiar revolving type, covered with dark green pantasote, and arranged in pairs, one seat of each pair being slightly in advance of the other, although the bases of the two opposite pairs are in the same transverse line. This gives the seats a staggered appearance, and allows the greatest amount of room for the passengers' feet; it also provides ample space for the standing passengers, and it is found that a conductor on a crowded car is enabled in collecting fares to work his way in and out among the seats with much greater facility than where the ordinary longitudinal type of seat is used. Pressure on a pedal under the seats enables them to be turned through a half revolution, and thus face the other way. No locking device is employed, so that the passengers can sit facing each other where a party of friends so desire. The seating capacity of the car is 40, there being nine double revolving seats on each side, and a fixed sofa seat at the ends. The doors are placed at the side of the platform, as shown in the front view of the car, so that ample room is provided for the sofa seat. The total capacity compares favorably with the standard cars on the road, but the comfort of both seated and standing passengers is greatly increased.

FIG. 2.—FRONT VIEW OF COMBINATION CAR.

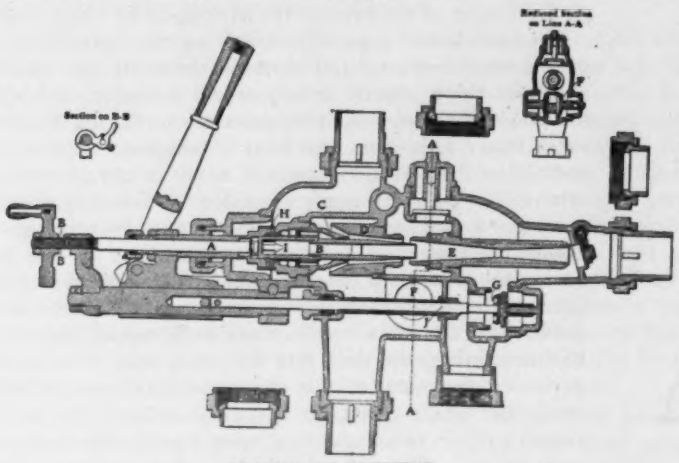
The car is furnished with Brill maximum traction trucks, and two Westinghouse type 68 motors of 40 hp each. K-11 controllers, circuit

breakers, lightning arresters, etc., complete the electrical equipment. The lighting consists of three center clusters and five single incandescent lamps on each side of the car. These give practically a half again more light than is customary. There is also a lamp under each platform hood, and electric headlights are used. Electric push buttons on a line with the lower window sill and conveniently placed at the hands of the passengers are provided for signaling the conductor. The car is heated by electric heaters, made by the Consolidated Car Heating Company, of Albany, N. Y. There are 11 of these heaters ranged along the side, a short distance above the floor.

The interior woodwork is of natural cherry, having a flat finish, and the headlinings are of quartered oak. The Brooklyn Heights Railroad Company operates parlor cars on certain lines, in which an extra charge is made, and many passengers on entering the new combination cars think that they have made the mistake of boarding a parlor car.

## An Improved Injector.

The injector shown in the accompanying illustration has a number of features which make it differ from like devices now on the market. By pulling the lever slightly the steam valve *H* is withdrawn from its



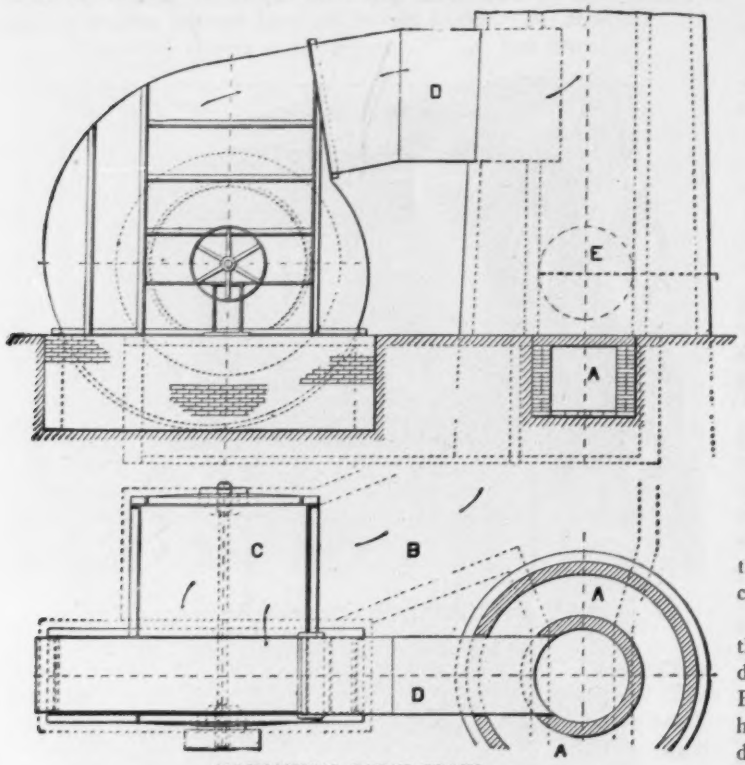
SECTION OF INJECTOR

seat and steam is admitted to the lifting steam jet *C* through the annular space around the movable steam tube *B*. The steam flowing into the water lifting tube *B* forms a vacuum in the water supply pipe and the water is "lifted" and passes out through the check valve *A* and the delivery tube *E*, past the overflow valve *G*, to the atmosphere. Drawing the handle farther back opens the ports *I I* in movable steam tube *B*, thus admitting steam to the interior of said tube, which forces the water through the combining tube *E* past the line check to the boiler, due to the closing of overflow valve *G* by the withdrawal of the rod *J*. The principal feature in this machine is that the regulation of the water is accomplished by the movement of the movable steam tube *B*, the amount of which is controlled by the crank handle at the end of the machine. On this account it differs from all other forms of injectors, inasmuch as, in cutting down the discharge of water, the steam consumption is reduced in direct proportion. In other forms of injectors the steam supply remains constant, while the water supply alone is reduced.

The manufacturer, the Lunkenheimer Company, Cincinnati, Ohio, claims that this injector will start promptly under most all conditions and can be depended upon to work reliably at all steam pressures from 25 lbs. to 300 lbs. and higher.

## Mechanical Boiler Draft.

The illustration given below shows the manner in which an induced draft fan may be applied to perform the work of a chimney which has proved itself inadequate. The boiler plant in this case had been increased from 1200 to 2000 hp. The original course of the gases was through the underground flues, *A A*, into the base of the chimney. With the increase in the boiler plant, a fan was installed instead of building another chimney, which would otherwise have been necessary, while the existing chimney was used merely as a discharge pipe from the fan. When in operation the fan draws the gases through the branch duct, *B*, into the chamber, *C*, whence they pass to the fan and under its positive action are discharged through *D* to the chimney. A damper, *E*, serves, when closed, to prevent passage of gases to the chimney through the old duct, *A A*. Under this condition the old chimney with damper, *E*, wide open meets the requirements for steam raising before the mill is started, but during working hours the fan is necessary to maintain the required output. Under the circumstances it is therefore perfectly feasible to drive the fan by belt and operate it only during these hours. The plant illustrated was installed by the B. F. Sturtevant Company, Boston, for the Wampanoag Mills, Fall River, Mass.

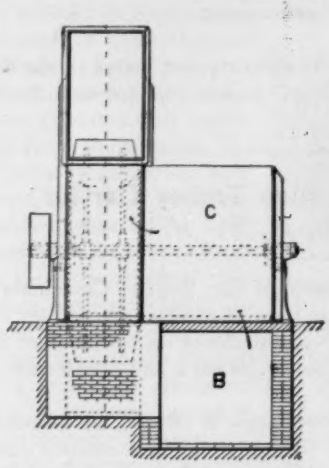


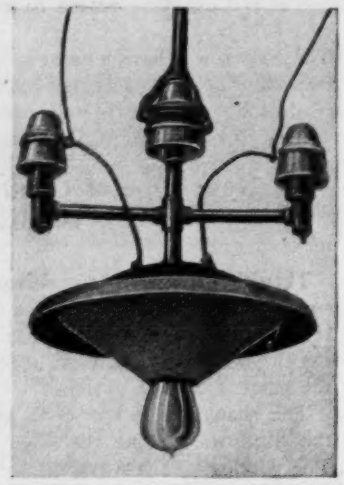

MECHANICAL BOILER DRAFT.

## High Potential Street Incandescent Hood.

By G. N. Tidd.

In carrying out a change in a municipal street incandescent lighting system from direct current 1200 volts, to alternating at 3200 volts, the writer encountered a serious problem in securing a suitable incandescent street hood at Chester, Pa.



INCANDESCENT LAMP HOOD.

In many locations the hoods were to be placed on iron poles, and there seemed to be no hood on the market which was satisfactory under these severe conditions. Consequently, in conjunction with Electrician Clinton Shain, the writer designed the hood illustrated herewith, which will explain itself. The insulator is of the ordinary double petticoat type, and the supporting fixture is of gray cast iron, made at a cost of something like 3 cents each.

The hoods have now been in constant service for two years under the worst climatic conditions, and we have yet to report the first failure. The same idea has, under Mr. Shain, been used in many ways, and in general central station practice should meet a variety of needs where a reliable insulating device is needed.

# NEWS OF THE WEEK.

## Financial Intelligence.

THE WEEK IN WALL STREET.—Rates for money closed at 3 @3½ per cent for 30 to 60 days. Call money closed at 2 per cent, and the rates for commercial paper were quoted at the close of the week at 3½@3¾ per cent for prime double names. Up to Thursday the stock market was very active, heavy transactions and large advances being recorded, due to the purchase of the Southern Pacific by the Union Pacific road, and the anticipated successful outcome of the negotiations for the purchase of the controlling interest in the Carnegie Steel Company. Industrial stocks materially advanced as a result of the latter situation. On Thursday, however, reports of an obstruction to the Carnegie negotiations depressed the market, which at the end of the week exhibited an unsettled feeling. The electric and traction securities, with one exception, closed the week with better prices than were last recorded here. General Electric made the largest advance of this list—6½ points. The week's range of prices was between 191 and 198, the sales being 4100. Western Union closed with a net gain of 2¾, and Brooklyn Rapid Transit 1⅜. Metropolitan Street Railway was the only exception in the list, closing with a net loss of 1 point. Trading in outside securities was of satisfactory proportions, and business was fairly well distributed. General Carriage was active but very irregular. The following are the closing quotations at the New York, Boston, Philadelphia and Chicago exchanges:

NEW YORK.

| | Feb. 2. | Feb. 9. | | Feb. 2. | Feb. 9. |
|---|---|---|---|---|---|
| Gen. Electric | 190½ | 197 | Elec. Veh. | 15 | 16 |
| Bklyn Rap. Tran. | 77 | 78⅜ | Elec. Veh., pfd. | 30 | 30 |
| Met. St. Ry. | 163½ | 162½ | Gen. Car. | 2⅜ | 2⅜ |
| Am. Tel. & C. | — | 96 | Ill. Elec. Veh. Tran. | ¾ | ¾ |
| West. Un. Tel. | 83¼ | 86½ | Hud. Riv. Tel. | 117 | 117 |
| Am. Dist. Tel. | — | 35 | N. E. Elec. Veh. Tran. | 2⅞ | 3 |
| Com. Cable | — | — | N. Y. Elec. Veh. Tran. | 4¼ | 4¾ |
| Elec. Boat | 27 | 27 | Tel. & Tel. Co. of Am. | 4 | 4 |
| Elec. Boat, pfd. | 53 | 51 | N. Y. & N. J. Tel. | 174 | 174 |

BOSTON.

| | Feb. 2. | Feb. 9. | | Feb. 2. | Feb. 9. |
|---|---|---|---|---|---|
| New Eng. Tel. | — | — | Erie Tel. | 58½ | 63 |
| Mex. Tel. | 2¼ | 2¼ | Gen. Elec., pfd. | *162 | — |
| Westing. Elec. | 55 | — | Am. Tel. & Tel. | 163 | 163 |
| Westing. Elec., pfd. | — | — | Boston Elec. Light | — | 210 |

PHILADELPHIA.

| | Feb. 2. | Feb. 9. | | Feb. 2. | Feb. 9. |
|---|---|---|---|---|---|
| Elec. Stor. Bat. | 72 | 75 | Phil. Elec. | 7⅛ | 7⅝ |
| Elec. Stor. Bat., pfd. | 72 | 75 | Pa. Elec. Veh. | 2 | — |
| Elec. Co. of Am. | 8¾ | 8⅛ | Pa. Elec. Veh., pfd. | 1 | — |
| Gen. Elec. Auto | — | — | Am. Rys. | 32½ | 33 |

CHICAGO.

| | Feb. 2. | Feb. 9. | | Feb. 2. | Feb. 9. |
|---|---|---|---|---|---|
| Chicago Edison | 150 | 150 | Chicago Telep. Co. | 255 | 260 |
| Chic. City Ry. | 255 | 255 | Union Traction | 11¾ | 12 |
| Nat'l Carbon | 15½ | 16 | Union Traction, pfd. | 49½ | 53½ |
| Nat'l Carbon, pfd. | 84 | 83 | Northwest. Elev. Com. | *31 | 34 |

* Asked.

NASSAU ELECTRIC GOLD BONDS.—The Guaranty Trust Company, of New York, and Harvey Fisk & Sons offer at 97½ and interest, and recommend to investors $9,500,000 Nassau Electric Railroad Company consolidated mortgage 4 per cent gold bonds, due Jan. 1, 1951, principal and interest guaranteed by the Brooklyn Heights Railroad Company, through which the Brooklyn Rapid Transit Company controls the properties of the Nassau Electric. The announcement is accompanied by a letter to the bankers from C. L. Rossiter, president of the Nassau Electric Railroad Company and of the Brooklyn Rapid Transit Company, containing exhaustive information regarding the property. In April, 1899, all the railroad properties and franchises of the Nassau Electric Railroad Company were leased to the Brooklyn Heights Railroad Company for 999 years, which company owns all of the common and preferred stock of the Nassau Electric Railroad Company, excepting $448,000 par value, and, besides, the Brooklyn Heights Railroad Company, the operating company for the Brooklyn Rapid Transit Company, controls by lease or ownership all the properties embraced in the Nassau Electric Company's system. For the year ending June 30, 1898, the net earnings of the Nassau's system largely exceeded the present entire interest charge upon the same. The net earnings of the Brooklyn Heights Railroad Company for the year ending Dec. 31, 1900, were $4,333,968, and after deducting all interest and rentals of leased companies, there was left a surplus of $529,101, to which there is to be added interest and rentals derived from holdings of stocks and bonds of the companies controlled by the Brooklyn Rapid Transit Company, amounting to $701,688, making the aggregate surplus income of that company $1,230,789. It is estimated that the Nassau system contributed at least $935,000 to the net earnings of the entire Brooklyn Rapid Transit Company, which were $4,333,968.

METROPOLITAN OF CHICAGO.—The directors of the Metropolitan West Side "L" have declared a dividend of 1½ per cent on the preferred stock, payable Feb. 28. This action has caused much disappointment, as a payment of 2 per cent was promised and generally expected. The declaration was made on the advice of prominent directors, while a number of others favored 2 per cent. It is the opinion in some quarters that the next semi-annual declaration will be 2½ per cent, to make 4 per cent for the year.

TELEGRAPH RUMORS.—The advance in Western Union has revived the rumor of a combinaton of telegraph companies as a means of reducing expenses and obtaining better results. There has been considerable figuring on the saving that would be effected by doing away with competitive offices of Western Union and the Postal companies in different cities. It is said that there could be a saving of $100,000 a year in New York City alone, with a saving over the country that would have a very sensible effect on dividends.

BOSTON LIGHTING CONSOLIDATION.—The project of a consolidation of the Edison Illuminating Company and the Boston Electric Light Company has been entirely abandoned and the offer of a lease guaranteeing 10 per cent by the Edison Company has been rejected.

INTERNATIONAL STEAM PUMP COMPANY.—Trading in the common stock of this company has become more active lately, upon expectations that it will be placed upon a dividend basis in May, possibly 4 per cent, although it is stated that this has not been decided upon.

HUDSON RIVER TELEPHONE.—Stockholders of the Hudson River Telephone Company will hold a special meeting on March 7 and vote on the question of increasing the capital stock from $3,000,000 to $4,000,000.

## Commercial Intelligence.

THE WEEK IN TRADE.—In the main, trade developments last week were favorable. Several lines of trade and some staples show irregularity, but this condition is not unusual at this season. The situation therefore is, on the whole, satisfactory and normal. The growth of the spring demand in distributive jobbing lines in the South and Southwest, *Bradstreet's* reports, was a feature of the week's development, and better advices as to the trade outlook come from the Northwest. Reports from the Pacific Coast are no less encouraging. Clearings undoubtedly reflect speculation in the enormous totals reported, but the gains outside the metropolis, in the country at large, indorse the reports from a number of cities of a total trade larger than a year ago. Railway earnings likewise point to a substantial gain over January a year ago, which marked the highest point reached up to that time in this branch of industry. Gross railway earnings of 78 roads for the month of January aggregate $48,641,000, a gain of 8 per cent over January a year ago. Southern and Southwestern lines show greatest relative gains, but increases on the granger and Central Western roads are also liberal. Iron and steel have been quiet but steady, and even strong as to price, with finished product, particularly structural material, in active inquiry. The business failures of the week, as reported by *Bradstreet's*, aggregated 245, against 238 the week previous, 231 the corresponding week last year, 193 in 1899, 278 in 1898 and 301 in 1897. In the metal market copper was quiet, transactions in small lots only being reported. The official quotations are 17c. for lake and 16⅝c. for electrolytic and casting stock.

LIGHTING IN MANILA.—Negotiations are now stated to be all but completed for the purpose of consolidating the interests of the Manila Electric Light Company and the Mule Tramway Company in the Philippine capital. The latter concern operates the only horse road in the city of Manila, which system will, under the new régime, be converted into electrical power. The existing road is 12 miles in length. The promoters of the enterprise propose to build about 10 miles of additional track in the city. The Electric Light Company has been a success from the very start. Its capacity will soon be doubled, two 400-kw generators built by the General Electric Company, also boilers from the Aultman-Taylor shops at Mansfield, Ohio, engines from the Buckeye Engine Company of Salem, Ohio, and pumps from the Stilwell-Bierce & Smith-Vaile Company of Dayton, Ohio, have just been shipped for service in the main plant. Bagnall & Hilles of Yokohama, Singapore and Manila, installed the original plant, which is of American equipment throughout. Mr. A. L. Bagnall, who, it will be recalled, is at present on a visit to the United States and can be found at the offices of the New York Insulated Wire Company, of 15 Cortlandt Street, states that he had been trying to bring about a merger in the two companies for the last 10 years. The delay has been caused by the long franchise that the horse road secured and the fact that the principal stockholders, who are resident in Spain, finding the road a most remunerative investment under present conditions, were

loath to sanction a change. Now, however, that the Electric Light Company is doubling its plant and power can be produced much cheaper than heretofore, it is anticipated that the companies will shortly be in a position to place contracts for material, equipment, etc., rendered necessary by a change in the tramway system.

BULLOCK SALES.—The following sales have been entered by the Bullock Electric Manufacturing Company, Cincinnati, Ohio, for the week ending Feb. 2: Joseph Joseph, Cincinnati, Ohio, one 50-kw engine type generator; Manning, Maxwell & Moore, New York, one 180-kw engine type generator, one 35-hp, one 50-hp and one 65-hp motor; Pittsburg Engineering Company, Pittsburg, Pa., one 30-kw engine type; American Sugar Refining Company, New York, one 50-hp motor; John L. Thomson Estate, Baltimore, Md., one 100-kw engine type; the New Schuyler Apartments, one 50-kw and one 25-kw engine type; Fore River Engine Company, Quincy, Mass., fourteen motors of miscellaneous sizes; this makes about forty Bullock motors in all which this company has purchased; U. S. Finishing Company, Greenwich, Conn., one 75-hp motor; Mosler Safe Company, Hamilton, Ohio, one 35-hp motor; Pacific Coast Borax Company, Bayonne, N. J., one 15-hp motor; this makes about twenty Bullock motors now in operation by this company; Wolf Process Leather Company, Summerdale, Pa., one machine, 80-kw engine type; Jacob Ruppert, New York, two machines, 60-kw, and switchboard, together with several small motors; National Enameling & Stamping Company, Baltimore, Md., one 65-hp motor; Christian College, Columbia, Mo., one 17½-kw engine type generator; Bergtheil & Young, London, Eng., one 225-kw type H generator and two 60-hp teaser equipment for operating newspaper press; Brown Hoisting & Conveying Company, Cleveland, Ohio, one 25-hp motor; Columbia Chemical Company, Barberton, Ohio, one 42½-kw engine type generator.

THE STANDARD UNDERGROUND CABLE COMPANY announces that it has organized a new department, known as the Eastern and Northeastern Sales Department, of which Mr. Charles J. Marsh, for many years and until now officially associated with the electric lighting companies of New York City, is the general manager, with offices at 56 Liberty Street, New York City. Mr. George L. Wiley continues as manager of the Eastern Sales Department, with offices at 56 Liberty Street, New York City. With these changes, increased facilities and division of territory, Mr. Wiley will give closer attention to the trade throughout the territory reserved by the Eastern Sales Department, which includes the State of New Jersey north of the city of Trenton, the entire State of New York, the States of Connecticut and Massachusetts west of longitude 72½ degs., Vermont, and the Canadian provinces of Quebec and Ontario east of and including Toronto; also the West Indies. Mr. Atlee B. Saurman, formerly assistant manager of the Eastern Sales Department at New York, will be manager of the Northeastern Sales Department, with offices at Boston, Mass., to be opened on or about March 1. The Northeastern Sales Department will include the States of Massachusetts and Connecticut east of longitude 72½ degs., Rhode Island, New Hampshire, Maine, and the maritime provinces of Canada.

SOUTH AFRICA.—Contracts are about to be placed in this market for the furnishing of a large water power plant which is to be erected in South Africa. The plant is intended to begin operations by developing about 12,000 horse power, which will entail an expenditure in the neighborhood of $500,000. The greatest secrecy is being pursued by the interested parties, who are believed to be well-known London capitalists. They have sent an engineer here and he will remain until the machinery is shipped. It is stated by local parties who have been invited to figure on the contracts that so far no information has been given them as to the exact purposes and location of the plant.

McINTOSH, SEYMOUR & COMPANY, of Auburn, N. Y. and New York City, have secured a contract for the furnishing of two 150-hp horizontal compound condensing engines for shipment to the Imperial Government Railways of Japan. The engines, which are to be utilized for electric light and power purposes, were ordered through the Japanese house of Mitsui & Company, whose New York offices are located at 445-7 Broome Street. This concern is buying considerable electrical machinery for various Japanese plants. The McIntosh-Seymour people are about to make shipment of three 750-hp horizontal compound condensing engines, which are to be utilized in the central generating station of the Compañia Carril de Ferro de Lisbon, the Portuguese title of the Lisbon Tramways.

THE BUFFALO, ROCHESTER & PITTSBURG RAILROAD has just closed various contracts for the furnishing of electrical equipment required for its new shops at Du Bois, Pa. The Westinghouse Electric & Manufacturing Company obtained the contract for the supply of one 150-kw direct current engine type generator, two alternating current generators and a number of motors for electric power transmission through the shops. Westinghouse, Church, Kerr & Company, New York City, secured an order for a 250-hp compound engine and two simple engines of 113 horse-power each. The Stirling Boiler Company of Chicago took the boiler contract, which calls for water tube boilers aggregating 600 horse-power.

PURCHASES FOR JAPAN.—Extensive purchases of electrical machinery, according to private advices from Japan, will soon be made in this country on account of various concerns which are interested in gold dust enterprises in the River Pechiri, Kitami Province, Hokkaido, Northern Japan. The services of a number of American experts will, it is reported, be also enlisted. Isaac & Company, Sale & Company and the American Trading Company of Yokohama are stated to be behind the schemes. On inquiries being made at the local offices of the latter company in the Johnson Building, Broad Street, it was said that no instructions had yet been received on the subject, but that they were expected by the next mail.

THE DIESEL ENGINE.—The Diesel Engine Company, Ltd., has commenced operations in England, its present offices being at 171 Queen Victoria Street, London. This company has acquired from Mr. R. Diesel the patent rights for Great Britain, the colonies and certain other countries for his internal combustion engine. Up to now the engine has been mainly developed to work with oil, but at the same time very successful results have been obtained with other fuels. These engines are now in course of construction in England and will shortly be placed upon the market.

THE ELECTRIC STORAGE BATTERY COMPANY, of Philadelphia, has recently closed a contract with the Youngstown & Sharon Street Railway Company, of Youngstown, Ohio, for the installation of two batteries of "Chloride Accumulators," to be used on its lines. Each battery, consisting of 288 cells, will have a capacity of 191 kilowatt-hours and will be operated in connection with differential boosters of 200 amperes capacity at the railway company's rotary transformer sub-stations, located 2 and 12 miles, respectively, from the power house.

THE SAO PAULO TRAMWAY, LIGHT & POWER COMPANY is about to extend its operations. Fred. S. Pearson, consulting engineer of the Metropolitan Street Railway, who is the leading spirit in the Brazilian concern, is now in Sao Paulo with a view to determine exactly what is to be done as to the company's further exploitation. He is expected to return inside of six weeks, when specifications will be drawn up for the furnishing of whatever is necessary by way of additional equipment, etc.

MR. W. B. ROMMEL, the chief engineer and general manager of the Lisbon Tramways Company, is expected in this country within the next few weeks with a view to placing additional contracts for equipment, etc. The Lisbon road, which is the first electric traction system in Portugal, is operated by the Portuguese Improvement Company of Bishopsgate Street Within, London, E. C. Wernher, Beit & Company, the London financiers, capitalized the company.

MR. C. ICHIKAWA, chief electrician of the Hokkaido Coal Mining & Railway Company of Japan, is now on a sojourn in America for the purpose of placing important contracts for electrical machinery to be used for lighting and operating the extensive coal mines of his company. Mr. Ichikawa, who is at present in Pittsburg, is expected to arrive in New York the latter part of this week.

MESSRS. ROBERT W. BLACKWELL & COMPANY, the well-known merchants and contractors of London, Eng., announce from their New York office that they have acquired the business of Messrs. Schiff, Jordan & Company, which will be carried on by them under the personal direction of Mr. L. E. Frorup as sales manager at 232 Greenwich Street, New York.

BALL ENGINE ORDERS.—The United Electric Plant, Baltimore, Md., has recently installed one 300-hp cross compound self-oiling engine, which was furnished by the Ball Engine Company, Erie, Pa. The Center Star Mining Company, Rossland, British Columbia, has recently installed a 150-hp self-oiling cross compound engine, built by the Ball Engine Company.

AN ELECTRIC LIGHT PLANT is about to be erected at Live Oak, Fla. Mr. C. Y. Byrd, whose address is care of Blackwell & Johnson, attorneys, located in the Florida town, will make the necessary purchases of the equipment, etc. The services are desired of a competent electrical engineer to superintend the erecting of the plant.

BRITISH TRACTION EQUIPMENT.—There have been some very important inquiries received in New York within the past few days for material, equipment, etc., required by various British electric traction companies. One inquiry alone calls for figures for the supply of no less than 2000 trucks.

TELPHERAGE.—The Consolidated Telpherage Company, Broad Street, New York, has closed a contract to put a small equipment in the Singer Sewing Machine factory at Elizabethport, N. J., for transferring parts from one section to another.

BATTERIES WANTED.—Mr. C. G. Wilcox, general manager of the De Pere (Wis.) Electric Light & Power Company, writes us that it will be in the market for a storage battery equipment.

THE SCRANTON TRACTION COMPANY of Scranton, Pa., is in the market for an engine for direct connection to a 1000-kw generator.

# General News.

## THE TELEPHONE.

TARPON SPRINGS, FLA.—A co-operative telephone company has been formed here.

HARTSELLE, ALA.—Mr. J. C. Rogers has sold his local telephone interests to S. L. Sherrill and L. O. Waldsmith.

ST. PETERSBURG, FLA.—The St. Petersburg Telephone Company is making arrangements to build a line to Tampa.

ST. JOSEPH, MICH.—The Twin City Telephone Company of St. Joseph and Benton Harbor has declared its twelfth dividend.

KOKOMO, IND.—The Jay Brothers, of this city, have purchased an interest in the Kokomo Independent Telephone plant. When completed it will cost $50,000.

WORTHINGTON, OHIO.—The Citizens' Telephone Company of Columbus will install a sub-exchange in this place. About fifty local subscribers have been obtained.

JEFFERSON CITY, MO.—The Daviess County Telephone Company of Gallatin has been incorporated by C. J. Bain, J. W. P. Love and M. L. Bain. The capital stock is $5,000.

UTICA, N. Y.—The West Canada Telephone Company has sold its interests to the Remsen & West Canada Creek Telephone Company, which latter concern will conduct the service in the districts of the two separate companies.

INDIANAPOLIS, IND.—The Indiana Supreme Court has decided that laying telephone wires under the sidewalk in front of a city lot is not a use of the street for which the owner of the lot is entitled to either damages or an injunction.

AUSTIN, TEX.—The Austin Telephone Company has been incorporated with a capital stock of $1,000,000. The incorporators are J. E. Boynton, J. B. Earle of Waco, C. H. Rose of Columbus, Ohio, J. S. Bailey of Wauseon, Ohio, and G. H. Baker of Defiance, Ohio.

RAVENNA, OHIO.—The Ravenna Home Telephone Company proposes to extend its lines to Sandy Lake and Windham. The company is using Eureka, Swedish-American and North instruments. Its switchboard, having an ultimate capacity of 500 drops, is of the Eureka Company's make.

ANDERSON, IND.—Fifty physicians of this city have decided to order out the Central Union telephones and agreed to use only those of the local company. They claim to pay $4,500 a year for telephones and think they can save half this amount by agreeing among themselves to use but one system.

ROCHESTER, N. Y.—The Rochester Telephone Company has opened an exchange at Brockport, N. Y., with 210 local subscribers and toll connections with this city. The rate for five-minute conversations has been placed at 20 cents. The company is also giving long distance service to other places in this vicinity.

HARTFORD CITY, IND.—The Central Union Telephone Company announces that it will enter the Hartford City field for local business. Heretofore it has contented itself with long-distance business, but the independent company, which has a large number of patrons here, has been making inroads on long-distance business.

ELYRIA, OHIO.—At the annual meeting of the stockholders of the Elyria Telephone Company, held a few days ago, the following officers were elected: W. E. Brooks, president; F. H. Sudro, vice-president; J. A. Dake, secretary and treasurer. The above, with Charles Savage, E. K. Mussey and S. B. Rawson, constitute the board of directors.

BOSTON, MASS.—At the annual meeting of the Southern New England Telephone Company the following directors were elected: M. F. Tyler, W. E. Downs, James English, S. E. Merwin, A. H. Robertson and J. W. Alling, all of New Haven; L. B. Jewell of Hartford and Thomas Sherwin and Alexander Cochran of Boston. The annual report showed net earnings for the year of $167,660, of which $150,660 was paid in dividends.

TOLEDO, OHIO.—The stockholders of the recently incorporated Toledo Telephone, Telegraph & Messenger Company have elected the following officers: J. H. Bellows, president; C. F. Watts, vice-president; H. A. Merrill, secretary; A. H. Hough, treasurer. An ordinance asking for a franchise will be presented to the City Council in two weeks. There will be a large main exchange in the centre of the city, with sub-exchanges in East Toledo, Air Line Junction, North Toledo and Auburndale.

WASHINGTON, D. C.—The Telephone Company of America which was recently incorporated under the laws of Delaware, will manufacture apparatus on the Frost central energy system. In introducing this system the company requires all local companies to place a telephone in every house and place of business. The company will supply its combination telephones and switchboards to local companies. It is stated that this system can be operated much cheaper than other systems. The line construction, it is claimed, is equally reduced in cost. It is also claimed that the Frost system can be installed for one-fifth the cost of the other systems, and each telephone will earn as much percentage of profit as each of the old-style instruments does now. Mr. T. W. Tryrer is secretary of the new company and Mr. E. F. Frost chief electrician.

## ELECTRIC LIGHT AND POWER.

HENRIETTA, TEX.—A contract for an electric light plant was closed Feb. 4 with E. B. Carver.

CLEBURNE, TEX.—The plant of the Cleburne Electric Light & Power Company was recently damaged by fire.

OTTAWA, ONT.—The water power of the Pen Dóreille River, in British Columbia, is about to be utilized by a New York company.

YARMOUTH, N. S.—A special committee of the Town Council has recommended the installation of a municipal electric light plant.

BROWNSVILLE, TENN.—The electric light plant here was totally destroyed by fire Feb. 2. It was valued at $8,000 and will be rebuilt at once.

HARTFORD, CONN.—The Hartford Electric Light Company is installing a 3000-hp steam turbine made by the Westinghouse Machine Company.

FARGO, N. D.—Stern Bros. has purchased the outside interests in the Fargo Edison Company, organized several months ago, from the Hughes Electric Company.

PARIS, ONT.—The ratepayers will vote on a by-law to raise the sum of $15,000 by debentures to purchase the electric light plant and operate the same under municipal ownership.

OTTAWA, ONT.—A company has been formed at the town of Bic, Quebec, with a view to purchasing the water power of Mr. Alf. Bouillion for the purpose of developing it electrically.

VINCENNES, IND.—E. J. Julian has been appointed receiver for the newly established electric light plant of Vincennes on complaint of the Consolidated Light & Water Company of Chicago.

WEIR CITY, KAN.—At a special meeting of the City Council, held Feb. 2, it was decided to ask the Legislature for permission to vote $60,000 municipal bonds to put in a light and water plant.

MONTREAL, QUE.—At the next session of the Quebec Legislature a number of Montreal citizens will make application to establish an electric plant near Riviere des Prairies, in Quebec Province.

CHERUBUSCO, IND.—The Seckner Contracting Company, of Chicago, to which the Town Council delivered the electric light and water works plant, will operate the same until a purchaser can be found.

LOUISVILLE, KY.—Between 16,000 and 17,000 incandescent lamps will be used in the street arches that will form part of the special decorations here on the occasion of the annual conclave of the Knights Templar.

PHILADELPHIA, PA.—Plans are being completed for a large power house to be erected at Conshohocken, Pa., for the Conshohocken Electric & Power Company. It will be modern in its construction and equipment.

OTTAWA, ONT.—The Keewatin Power Company and the Lac du Bonnet Power Company of Manitoba are said to have made propositions to transmit electric power to the city of Winnipeg. The distance from Keewatin to Winnipeg is about 130 miles.

ELKHART, IND.—Articles of incorporation have been filed by the Elkhart Electric Company; capital, $100,000. The company has absorbed the Home Electric Light & Power Company and will assist in developing the power of the St. Joseph River.

LIVERMORE, CALIF., is now without electric lights, the creditors of the promoter of the electric light system having dismantled the generating plant. It is supposed that the Livermore Water & Power Company will install a lighting plant in the near future.

OTTAWA, ONT.—The Maitland River Power Company of Goderich, Ont., has made a proposition to operate the water works and electric light plant of the town. The company has in view the development of the water power of the Maitland River at an estimated cost of $100,000.

MOUNT VERNON, ILL.—Owing to the transfer of the electric light plant, Mount Vernon has been in darkness for the past month, but the lights are now burning. With the change in location the control of the plant passes from the Mount Vernon Electric Light Company to the city.

BANGOR, MAINE.—A hydraulic-electric power plant is to be established at Sangerville, this State. Water privileges have been obtained on Carleton stream and an electric lighting plant will be established. A new dam will be constructed, also a power house. The estimated cost of the plant is $10,000.

CINCINNATI, OHIO.—The Fort Wayne Electric Works have closed a contract through the Cincinnati office with the Water Works Board at Leipsic, Ohio, for a complete power outfit to drive the deep well pumps in the new plant. The Gould Manufacturing Company will install the pumps, each to be driven by a 5-hp motor.

MANCHESTER, N. H.—A bill has been introduced in the Legislature to change the name of the consolidated electric interests in this city to the Manchester Traction, Light & Power Company. The company controls nine electrical companies, five of which are actively doing business under the general head of the Manchester Electric Company.

MINNEAPOLIS, MINN.—The Guaranty Building is to have a new lighting plant within the next 60 days. The contract calls for two 125-hp Corliss engines, direct connected to direct-current generators of 80-kw each. The Twin City Iron Works will build the engines and the Electric Machinery Company of Minneapolis will install the generators and switchboards.

HUDSON, WIS.—The annual meeting of the St. Croix Power Company was held here on Jan. 28. Messrs. Lathrop, Baker and Crawley were elected directors. Officers were chosen as follows: President, A. P. Lathrop, St. Paul; vice-president, H. C. Baker, Hudson; secretary and treasurer, Y. P. Crawley, St. Paul. The company has power developed on the Apple River, in this county, and transmits electricity to St. Paul for lighting the city.

SEATTLE, WASH.—The Seattle Electric Company has inaugurated a new schedule of rates based upon the two-rate principle. The rates are 20 cents per kilowatt-hour for the first hour's average use of lamps, 8 cents for the next four hours, and 4 cents for all use in excess of five hours. A discount of 10 per cent will be granted for prompt payment of bills. The company is also offering to replace, free of charge, burned-out or blackened lamps for all meter customers.

OTTAWA, ONT.—Another large electric company is being formed at Ottawa, provided a charter can be obtained from the City Council. Mr. J. W. McRae, late managing director of the Ottawa Electric Company, is the chief promoter of the scheme. The new company is to be called the Consumers' Electric Company, and by its charter will have the power to carry on its business in Ottawa and elsewhere, for the purpose of producing and supplying electric current for electric light, heat and power.

SAN FRANCISCO, CALIF.—The Consumers' Electrical Association of San Francisco is installing an elaborate and extensive electric plant at the new seaside cottage of Hugh Tevis on the bay, in Monterey. The generator will be direct connected to a large gasoline engine. A Willard storage battery plant of sufficient capacity to supply 500 incandescent lights will be installed. The plant will also be used as a charging station for electric automobiles and a 40-ft. electric launch, which was recently purchased by Mr. Tevis. A direct connected electric hoist will lift the launch out of the water whenever it is necessary.

OTTAWA, ONT.—The annual meeting of the shareholders of the Ottawa Electric Railway Company was held at Ottawa on Jan. 30. The annual report and financial statement for the year ending Dec. 31, 1900, showed a most satisfactory year's business. Four quarterly dividends of 2 per cent each were paid, and a substantial balance carried to the credit of profit and loss. The following directors were elected: Messrs. T. Ahearn, Geo. P. Brophy, C. E.; Peter Whelen, Warren Y. Soper, Thos. Workman, A. Lumsden and Hon. Senator Cox. Mr. T. Ahearn was elected president, Peter Whelen vice-president, and James D. Fraser secretary-treasurer.

## THE ELECTRIC RAILWAY.

PORTLAND, MAINE.—The Westbrook, Windham & Naples Railway Company has been sold to the Portland Railroad Company.

GAINESVILLE, GA.—There is talk of an electric railway here. It is said that Mr. Montgomery, of the Pacolet Cotton Mills, is interested.

SACRED HEART, MINN.—This village proposes to have an electric railway. Bonds have been voted for the same by the Farmers' Mill Company.

MINNEAPOLIS, MINN.—The Twin City Rapid Transit Company of St. Paul and Minneapolis contemplates expending about $500,000 for improvements in the two cities.

CHESTERTOWN, MD.—The Chestertown Light, Power & Railway Company has been granted the use of the streets and will construct an electric railway in the near future.

ANDERSON, IND.—The Union Traction Company has voluntarily increased the wages of 200 conductors and motormen and made eleven and one-half hours a day's work.

BALTIMORE, MD.—A franchise has been granted the Baltimore, Halethorpe & St. Denis Railway Company to construct an electric railway on Wilkins and Beachfield avenues.

INDIANAPOLIS, IND.—Plans are formulating to connect this city and Cincinnati, Ohio, by a chain of interurban lines. Companies have been organized to build each of the links.

DETROIT, MICH.—The steam railway between Paw Paw Lake and Coloma has been purchased by the South Haven & Paw Paw Railroad Company and will be transformed into an electric road.

BALTIMORE, MD.—The Kent County Commissioners have granted right of way to the electric light and power company at Chestertown to run an electric railway from Chestertown to Tolchester and Rock Hall.

HUNTINGTON, IND.—W. S. Reed, manager of the Fort Wayne & Southwestern Traction Company, has contracted for the machinery for the company's power house, to be located in this city. The orders aggregate $60,000.

CINCINNATI, OHIO.—Powel Crosley and C. T. McRae have received from the Hamilton Traction Company $10,000 for their option on the Cincinnati & Southwestern Railroad, which has been taken over by the electric traction interests.

BUFFALO, N. Y.—It is stated that the Niagara Falls, St. Catharines & Toronto Electric Railway Company has completed arrangements with the International Traction Company which will give direct service between Buffalo and Toronto.

BOSTON, MASS.—The Berkshire Street Railway, of Pittsfield, Mass., has been incorporated with a capital stock of $1,100,000, to build an electric railway from Adams to the Connecticut State line. Among those interested are R. D. Gellett of Pittsfield.

PITTSBURG, PA.—The management of the Consolidated Traction Company, of this city, is contemplating a number of improvements in the equipment, the rolling stock and the operation of the entire system. Among other things the company will order 100 new cars.

MANITOWOC, WIS.—Surveys are in progress for an electric railway from this city to Two Rivers, a distance of about 6 miles. The surveys are being made in the interest of Thomas Higgins, who owns an electric railroad at Marinette, and who is said to intend extend the line to Mishicotte and Green Bay.

GREEN BAY, WIS.—It is reported that an option on the street railway system and all the property of the Fox River Electric Railway & Power Company of this city has been given to representatives of New York capitalists, who are back of a plant to establish an electric railway between Green Bay and Manitowoc.

DANVILLE, IND.—J. V. Edwards and others have petitioned the County Commissioners for a franchise for an electric railway to Rockville. The Western Indiana Railway Company has petitioned the commissioners for a franchise for an electric line from this city to North Salem, Lodago and Crawfordsville.

MANKATO, MINN.—The Mankato Electric Street Railway, Lighting & Power Company is about to be transferred to an Eastern company. The consideration is $10,000 for the franchise and rights. The electric road has been surveyed and plans drawn. The company plans to run an electric line between Mankato and Le Queen Centre. A line will also be built to Eagle Lake, St. Clair and Elmer City, Minn.

CINCINNATI, OHIO.—Promoters of the scheme to substitute electric service on the Miami & Erie Canal between Dayton and Cincinnati are strongly censured in the annual report of the Ohio Canal Commission. The protest is made after a conference with the chief engineer and State Board of Public Works, and is expected to cause considerable trouble. T. N. Fordyce has the lease to the berme bank of the canal and has already begun preparations for the change.

DETROIT, MICH.—The Detroit & Chicago Traction Company was incorporated recently by P. H. Flynn, John McCarthy and F. C. Cocheu, of New York; Isaac W. MacClay, Yonkers, N. Y.; George J. Carr, of Montclair, N. J.; W. A. Boland, of Grass Lake, Mich., and W. A. Foote, of Jackson, Mich. The company has an authorized capital of $4,000,000. Its object is to build an electric railway from Detroit to Chicago, as well as lines in the various cities and towns in Michigan and Illinois.

BROOKLYN RAPID TRANSIT CAR HOUSE BURNED.—On the night of Feb. 8 fire destroyed the Flatbush car sheds and several cars of the Brooklyn Rapid Transit Company, entailing a loss estimated at $250,000. The building, which had a frontage of 125 ft. on Flatbush Avenue, extended back 600 ft. It served as headquarters for the Flatbush, Nostrand Avenue and Lorimer Street lines, all of which were tied up for three hours as a result of the fire. There were 150 cars in the building at the time and only 40 of these were saved intact, it is said. Many of the cars destroyed were open cars, and some were entirely new.

## THE AUTOMOBILE.

INDIANAPOLIS, IND.—C. Koehring & Bro. have purchased and succeeded to the automobile business of Carl G. Fisher, in this city. Mr. Fisher announces that he will associate himself with others for the purpose of manufacturing automobiles.

A FRENCH AUTOMOBILE FOR MRS. MACKAY.—A Paris dispatch states that an order has been received there by cable from Mr. Clarence Mackay for an automobile for his wife. The dispatch adds that this machine will beat anything of the kind in America. The automobile is being built by Charron, Girardot & Voight, and will cost $17,000.

COLUMBUS, OHIO.—The Post Office authorities in this city are considering a proposition made by the Columbus Auto Cab & Vehicle Company to carry the mail to and from the railway stations and to make those collections which are now made by wagon, at less cost than under the present system. The Auto Company also intends to run automobiles to the parks and about the city.

BOSTON AUTOMOBILE SHOW.—The projectors of the Automobile Show, which is to be held in Boston early next month, express satisfaction with the manner in which the preliminary arrangements are advancing, and are confident that there will be a large display of automobiles and accessories. The Massachusetts Automobile Club will take an active interest in the management of the show, which, there is every reason to believe, will be an entire success.

A RECORD RUN IN SAN FRANCISCO.—Mr. H. M. Sessions, manager of the Consumers' Electrical Association, San Francisco, recently made a record-breaking run with a Woods electric road wagon. He made the round trip from Montgomery Street to the ocean beach at the Cliff, a distance of about 17 miles, in 55 minutes. This was over the Point Lobos road with a two-mile hill to be overcome.

AUTOMOBILES IN CANADA.—The invasion of the automobile is spreading in Canada. The recently organized Electric Cab Company, of Toronto, Ont., will have cabs and tourist brakes on the streets of Toronto as soon as they can be turned out of the factory. The company now proposes to extend its business to Ottawa and other large Canadian cities. At a meeting of the stockholders a few days ago it was decided to double the capital of the company and go into wider fields of operation.

## LEGAL.

STEAM AUTOMOBILES.—A verdict has just been rendered in the Supreme Court of this State by which automobiles run by steam are placed in the same category and under the same restrictions as other steam engines using the public highways. Such engines must be preceded at an eighth of a mile by a runner whose duty it shall be to warn vehicles that it is coming. Whether this man shall carry a red flag has not yet been judicially decided. Louis W. Moore, of Watertown, has been assessed heavy damages in the Supreme Court in Saratoga County for causing a runaway which destroyed the vehicle of Dr. T. Royal Cook, of Ballston Spa, N. Y., and seriously injured a valuable horse. The case was tried before Justice Russell. The evidence showed that the defendant was running along one of the highways of Saratoga in a locomobile driven by steam. It frightened Dr. Cook's horse. Judge Russell held that a steam locomobile was bound by the law which compels its driver to send a man ahead of it, at a distance of an eighth of a mile, to warn travelers of the approach of such a vehicle. As Mr. Moore had no such protection, it was for the jury to decide whether he was not guilty of culpable negligence. The jury decided that he was, and gave a verdict for the plaintiff. This is the first case in the Supreme Court of this State in which the rights and duties of one operating a steam automobile were defined.

## OBITUARY.

MR. OTTO W. MEYSENBURG, president of the Rodger Ballast Car Company, formerly president of the Siemens-Halske Electric Company of America, and ex-president of the Wells-French Car Manufacturing Company, died on Feb. 11 at Alma, Calif., of typhoid fever. He was 52 years old.

MR. HENRY C. DAVIS, a well-known Philadelphian, at one time president of the Sawyer-Man Electric Company and of the old Electric Club, died at his home on Jan. 30 at the age of 62. He had many large business interests, but always took an active part in electrical matters. He was a grandson of Lucretia Mott, the abolitionist, and himself gave much of his time and money to the elevation of the negro. He leaves a wife, two daughters and a son, Mr. C. H. Davis, the electrical engineer, of this city.

MR. R. P. BROWN.—Robert Pond Brown, formerly chief engineer in charge of the electrical equipment of the Brooklyn Heights Railroad Company, died last week in New York City. He had been suffering from kidney trouble since last spring and was compelled to give up his work in Brooklyn on Dec. 15 last. He was only 35 years old, a native of Whiting, Vt. He was graduated from Tufts College as an electrical engineer in 1891, and later took charge of the construction department of the West End Railroad Company of Boston. He went to Brooklyn for the Brooklyn Heights Company eight years ago.

## PERSONAL.

MR. NIKOLA TESLA has a signed article in *Collier's Weekly* on his communications with Mars.

MR. EDWARD LYNDON has become associated with the Gould Electric Car Lighting interests in New York City.

PROF. G. F. SEVER, and Mr. Henry Rustin contribute articles to the January *Pan-American Magazine* on electricity and electrical exhibits at the coming exposition.

MR. E. T. PARDEE has become associated with the Bullock Electric Manufacturing Company and will have his office as its New England representative at 70 Kilby Street, Boston.

MR. W. H. JOHNSON, second vice-president of the Electric Vehicle Company of New York, is visiting San Francisco on business connected with the local agencies of his corporation.

MR. MARTIN J. INSULL, of the General Incandescent Arc Light Company, has been suffering from the strain of overwork due to heavy business and is now recuperating for a week or two at Atlantic City.

MR. FRANCIS B. SMITH, an electrical engineer, will have the management of the office which the Bullock Electrical Manufacturing Company is opening at Buffalo. His office will be at 675 Ellicott Square.

MR. W. S. HEGER, manager of the San Francisco agency of the Westinghouse Electric & Manufacturing Company, recently returned home after an extended tour of the principal cities of the Eastern States.

PROF. ELIHU THOMSON has an admirable review of electrical development during the nineteenth century in the New York *Sun* of Feb. 10. It is several columns in length and bristles with names, dates and facts, besides being charmingly written.

MR. PAUL D. CABLE has severed his connection with the Rumsey-Sikemeier Company to take up the presidency of the Missouri Electrical Manufacturing Company of St. Louis. The object of the company is to do a general supply and jobbing business and to make certain specialties that it can handle to advantage.

CAPT. G. O. SQUIER writes from Manila, P. I., that the cable ship Burnside reached the islands on Dec. 6 in good condition and that they had been very busy since then up to the time of writing in mounting the special cable machinery on board. He was hoping to start out before the beginning of January, cable laying.

## Trade Notes.

REMOVAL.—The Gordon Battery Company, New York, has moved its place of business to 13 and 15 Laight Street.

EXHAUST HEADS.—The National Steel Works recently ordered one 24-in. exhaust head from the Burt Manufacturing Company, Akron, Ohio.

THE AMERICAN BRIDGE COMPANY announces its sales during the month of January as the largest of any month since the organization, aggregating over 60,000 tons.

CHICAGO FUSE-WIRE & MANUFACTURING COMPANY.—A recent fire in the building in which the Chicago Fuse-Wire & Manufacturing Company is located caused the company some loss.

THE WESTERN ELECTRIC COMPANY, Chicago, has a large stock of pins, brackets and cross-arms which it is offering at very attractive prices at the beginning of the spring construction season.

ELECTRIC CRANES.—Messrs. Struthers, Wells & Co., of Warren, Pa., are making an addition to their machine shop. It will be used as an erecting room, and an electric crane will be installed therein.

THE NILES TOOL WORKS at Hamilton, Ohio, are installing an electric light plant, including a 500-hp compound condensing Corliss engine and a General Electric 500-hp generator. Fifteen new motors are being added to the present equipment.

THE ELECTRIC MOTOR & EQUIPMENT COMPANY, Newark, N. J., electrical engineer and contractor, is distributing a "Ten-Year Calendar" which is neatly and tastefully gotten up. It will be useful for a long period and will serve to keep constantly in mind the company who issued it.

THE AMERICAN VITRIFIED CONDUIT COMPANY is distributing a very effective paper weight in the shape of a miniature section of its underground conduit. It is safe to assume that any papers upon which this weight is used will stay there in good condition, just as the cables laid in this company's conduit stay in good condition.

THE ELECTRO-DYNAMIC COMPANY, of Philadelphia, in order to meet its increased business, has had to enlarge its factory and move its business to a more convenient location. It is now occupying 212-226 Ionic Street, and with its additional space and new equipment is better prepared than ever to promptly fill orders for its apparatus.

STORAGE BATTERIES IN RAILWAY PLANTS.—In a circular of recent issue by the Electric Storage Battery Company, Philadelphia, the storage battery plant of the Peekskill Lighting & Railroad Company is described. The advantages of the use of batteries on small roads are discussed and figures are given showing the economy of operation on this line.

COLUMBIA CALENDAR.—The Columbia Incandescent Light Company, St. Louis, Mo., is sending to central stations, isolated plants and other patrons, a calendar for the first four months of the new year. The card bearing the calendar contains illustrations of the various styles of lamps manufactured by the company, and in the centre is a picture of the company's plant in St. Louis.

LOOMIS AUTOMOBILES.—The Loomis Automobile Company, Westfield, Mass., is manufacturing a full line of gas automobiles. The company also supplies fittings to those wishing to construct their own vehicles, and is prepared to furnish such parts as running gears, bodies, carburetors, mufflers, etc. The company's muffler for reducing the noise of exhaust is described and illustrated elsewhere in this issue.

MR. GEORGE WILLIAM HOFFMAN, of Indianapolis, Ind., maker of the U. S. metal polish, reports that business is booming with him. He states that one customer who has been using his polish has just sent in an order for five barrels and ten cases, and that a number of other large orders have come in from people who have given the polish a trial, which justifies Mr. Hoffman's motto, "Once used, always used."

POLYPHASE MACHINERY.—The General Electric Company describes and illustrates in Bulletin No. 4239 its polyphase machinery. Among the views shown are various plants in which three-phase apparatus is used. The company has also issued catalogues and price lists of marine supplies, repair parts of GE-55-A railway motor and of D lever switches; also a leaflet giving illustrations and prices of GE porcelain knobs and cleats.

"SALARIED POSITIONS FOR LEARNERS" is the title of a pamphlet issued by the International Correspondence Schools, Scranton, Pa. It tells how a young man can become a mechanical or electrical engineer or architect and support himself while learning. It contains photographs of a score or more students who have obtained better positions as a result of their studies, and some specimen drawing plates showing the progress made by students.

"A LITTLE BOOK ABOUT FANS" has been issued by D. L. Bates & Bro., Dayton, Ohio. This firm manufactures ceiling fans for direct current only, and desk and bracket fans for direct and alternating currents. The fans of both classes are of various styles, to suit different tastes. The ceiling fans are made with and without electroliers. The firm also makes electrolier column fans. The desk fans are compact in design and highly efficient machines.

THE VARLEY DUPLEX MAGNET COMPANY has changed its factory address to Phillipsdale, R. I. The company believes that this change will be advantageous to its customers, and all delays in the execution of orders will be avoided. The American Electrical Works of Phillipsdale, R. I., will have the right, on and after Feb. 11, 1901, to solicit and accept orders for "Varley Windings." All orders placed through them or their agents will be accepted by the Varley Company.

THE TRIUMPH ELECTRIC COMPANY, Cincinnati, Ohio, has sold for installation in the steamer "Exporter," running between St. Louis and New Orleans, a complete electric plant consisting of a vertical engine with direct connected generator. The same company has sold through Thebaud Brothers, exporters, several machines to go to Merida, Mexico, one to Mexico City and one for British Honduras. The consignment to Mexico and British Honduras is intended for lighting service.

AIR COMPRESSORS.—The Clayton Air Compressor Works, New York, in a recently issued catalogue, illustrates and describes the many types of Clayton air compressors, air receivers, vacuum pumps and other lines of apparatus produced by this concern. The catalogue also contains full information relative to the transmission of compressed air and capacity lost by air compressors in operation at various altitudes. It is a very complete work of its kind, and a copy may be obtained upon application.

THE PAN-AMERICAN FOUNTAIN.—The plant for serving power for the spectacular fountain in the electric tower basin at the Pan-American Exposition consists of one Keystone generator direct connected to an engine manufactured by the Ball Engine Company, of Erie, Pa.; also a Keystone generator of the belted type, driven by a Skinner engine. The D'Olier Engineering Company, of Erie, Pa., is the general sales agent for the Keystone Electric Company. This company will install its switchboard in the plant above referred to.

INCANDESCENT LAMP TESTS.—The Western Electric Company has issued a bulletin in large folio form entitled "Comparative Incandescent Lamp Tests." The tests refer to 12 lots of lamps of different manufacture and consisted of both efficiency and life tests. Large target diagrams are given for each make of lamp, and the results are submitted to an analysis to determine their bearing from the dollars and cents standpoint. This analysis shows that in some cases the comparative lack of economy was such that had the consumer obtained the poorer lamp without charge he would yet be a loser owing to the greater consumption of energy.

DISSOLUTION AND REORGANIZATION.—The firm of the Walker Electrical Construction Company, Philadelphia, Pa., has been dissolved for the purpose of continuing the manufacture of electrical appliances under a new copartnership which has been formed under the Pennsylvania State laws with the name and style of the "Walker Electric Company, Registered." The company's headquarters will be at Eighteenth and Hamilton Streets, Philadelphia. It will conduct a business of manufacturing and selling switchboards, switches and other electrical appliances and apparatus. The company has greatly increased facilities and is prepared to fill contracts promptly. The members of the firm are Henry H. Walker, F. Dinwiddie Walker, Bennett L. Johnson and Hervey S. Walker.

VENTILATION OF RAILWAY SHOPS.—The new shops of the Colorado & Southern Railway, just completed at Denver, Colo., are noticeable for the introduction of many features conducive to the comfort and welfare of the workmen. Among these is a complete equipment for both ventilating and heating the entire plant by the blower system. Separate apparatus furnished by the B. F. Sturtevant Company of Boston, Mass., consisting of fans and heaters, are installed in the machine and car shops. Air distribution is secured through a complete system of galvanized iron piping. A clear atmosphere is also maintained in the forge shop by means of a large Sturtevant exhauster arranged to draw the smoke and gases from the 18 special down-draft forges, also furnished by the same company.

A FAN PROPOSITION.—The Emerson Electric Manufacturing Company, St. Louis, offers to send to electrical dealers or central stations of financial responsibility in the United States, on request, one sample each of such types of its 1901 desk and ceiling fan motors as may be designated on a postal card order which it supplies for the purpose. It offers to take back the samples after 30 days' trial if for any reason it should be desired to return them. The Emerson Company pays transportation charges both ways. The company carries a stock and endeavors to make prompt shipment of fans of standard voltages and alternations, both from St. Louis and New York City. It has completed arrange-

ments with the following named firms, who will act as the company's special selling agents: H. C. Roberts Electric Supply Company, Philadelphia, Pa.; Doubleday-Hill Electric Company, Pittsburg, Pa.; Western Electrical Supply Company, St. Louis, Mo.; California Electrical Works, San Francisco, Calif. Each of these firms will be able to promptly fill orders from a large and well-assorted stock, at the company's regular schedule prices.

# Record of Electrical Patents

UNITED STATES PATENTS, ISSUED FEB. 5, 1901.

[Conducted by William A. Rosenbaum, Patent Attorney, Times Bldg., N. Y.]

667,134. FORM FOR WINDING ARMATURE COILS; J. W. Lundskog, Lynn, Mass. App. filed Nov. 12, 1900. The form is provided with a terraced edge and provided with extensible parts whereby coils of different form and size can be wound upon a single apparatus. (Issued Jan. 29.)

667,135. RHEOSTAT; G. F. Martin, Corydon, Ind. App. filed June 5, 1900. The resistance of a Leyden jar is regulated by controlling the extent to which the outer coating extends over the jar. (Issued Jan. 29.)

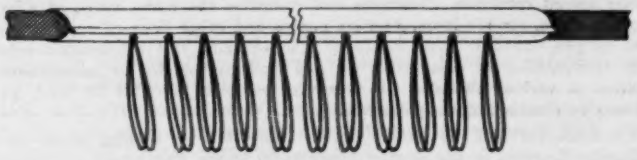
667,189. BATTERY BOX OR TRAY FOR MOTOR VEHICLES; G. Condict, New York, N. Y. App. filed Sept. 3, 1898. The tray is wedge-shaped and contacts connected with the battery are located on the outside thereof to engage with yielding contacts on the frame of the vehicle. The shape of the tray insures constant and good contact.

667,195. TELEPHONE SWITCHBOARD CONNECTION; T. V. Davis, Chicago, Ill. App. filed April 28, 1900. A device for cable connections, comprising a casing with a series of slots or indentations alone one edge to receive and hold the connections leading from the cable, and means associated with said casing for holding the edges together when the conductors are in place.

667,220. DENTAL ENGINE; W. G. Hughes, Pittsburg, Pa. App. filed March 7, 1900. On the motor shaft is a cup-shaped disk upon the outer side of which a frictional power-transmitting wheel impinges. The motor and disk can be swung bodily to alter the position of the friction wheel upon the disk and so change its speed of rotation.

667,246. ELECTROMAGNET BRAKE SHOE; F. C. Newell, Wilkinsburg, Pa. App. filed April 28, 1900. A magnetic brake shoe device having a body or core made up of a series of plates or laminations secured together and provided with wear shoes at its ends, or poles.

667,275. ELECTRIC MOTOR; G. E. Weisenburger, Sharon, Pa. App. filed Feb. 21, 1900. A motor for electric vehicles, constructed so that its field



667,195.—Telephone Switchboard Connection.

magnet and armature both rotate, one being connected to one wheel and the other to the other wheel on the same axle, thus avoiding compensating gear.

666,327. TELEPHONE TRANSMITTER; T. Lidberg, Chicago, Ill. App. filed Oct. 3, 1900. (See Current News and Notes.)

667,336. TROLLEY HEAD; E. S. Reed, Hill City, Tenn. App. filed June 20, 1900. The trolley head is connected with the end of a pole so as to be capable of an axial rotation between certain limiting stops.

667,366. LIGHTNING ROD; E. J. Hansen, Atlantic, Ia. App. filed May 22, 1900. A lightning rod consisting of a heavy central spring core support, copper wires twisted together upon themselves into ropes, said ropes laid in juxtaposition upon said tempered spring central core-support, and spirally wound or twisted thereon.

667,372. ELECTRIC ARC LAMP; H. O. Swoboda, New York, N. Y. App. filed June 15, 1900. The gas cap is spring-supported upon the upper end of the inner globe.

667,374. ELECTRIC HEATER FOR LIQUIDS; J. A. G. Trudeau, Ottawa, Can. App. filed April 4, 1900. The heater is constructed to pass a current through the body of liquid to be heated.

667,421. MEANS FOR CONNECTING ELECTRODES; H. Blackman, New York, N. Y. App. filed June 6, 1899. The electrode is formed with holes at its upper end, into which extend conducting rods, and separable conducting rings surround the rods and make contact with the walls of the holes.

667,434. SIGNALING SYSTEM; W. F. Follett, New Haven, Conn. App. filed June 22, 1900. A duplex receiving instrument responding to the conjoint action of a group of signals each of which alone is insufficient to elicit a full response from the duplex instrument.

667,442. PUMP GOVERNING MECHANISM; E. R. Hill, Wilkinsburg, Pa. App. filed July 2, 1900. Fluid pressure actuated devices are adapted to open a normally closed switch, and an electromagnet which is controlled by the degree of pressure in the system, itself controls the fluid which actuates said devices.

667,448. SIGNAL FOR TRUNK LINES; F. R. McBerty, Downer's Grove, Ill., and J. L. McQuarrie, Chicago, Ill. App. filed Jan. 11, 1897. (See Current News and Notes.)

667,454. FAC-SIMILE TELEGRAPH; A. Pollak, Szentes, Austria-Hungary. App. filed Feb. 17, 1899. A fac-simile telegraph comprising a transmitting device having a series of selenium cells, means for varying the illumination of such cells in accordance with the message, and means for sending current impulses through such cells successively, whereby such impulses individually correspond with the successive points of the message, a receiving device having a vibrating member adapted to respond to such impulses to reproduce such successive points of the message, and means for so suppressing the after-vibrations of such vibratory member that its response to the current impulses may be substantially unaffected by such after-vibrations.

667,460. TELEPHONE EXCHANGE APPARATUS; C. E. Scribner, Chicago, Ill. App. filed Sept. 25, 1896. (See Current News and Notes.)

667,461. APPARATUS FOR TELEPHONE SWITCHBOARDS; C. E. Scribner, Chicago, Ill. App. filed Jan. 9, 1897. (See Current News and Notes.)

667,462. SIGNAL LAMP FOR TELEPHONE SWITCHBOARDS; C. E. Scribner, Chicago, Ill. App. filed March 9, 1898. (See Current News and Notes.)

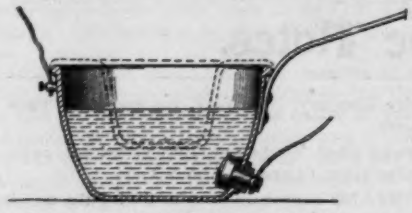
667,463. SIGNALING APPARATUS FOR TELEPHONE SWITCHBOARDS; C. E. Scribner, Chicago, Ill. App. filed June 7, 1899. (See Current News and Notes.)

667,484. DEVICE FOR DISINFECTING TRANSMITTERS AND RECEIVERS OF TELEPHONES; C. F. Axell, New York, N. Y. App. filed May 25, 1900. A distributor of ozone is attached to the transmitter.

667,498. ELECTROLYZER; W. T. Chapman, Manchester, Eng. App. filed Sept. 12, 1900. Details.

667,503. PHONOGRAPH ATTACHMENT FOR TELEPHONE CIRCUITS; A. B. Clark, Nashville, Tenn. App. filed July 10, 1900. (See Current News and Notes.)

667,509. CURRENT COLLECTOR FOR ELECTRIC RAILWAYS; F. C. Esmond, New York, N. Y. App. filed Nov. 17, 1899. The collector comprises a number of metallic plates grouped together on edge and upheld from a common support to form a unitary device, but having each an independent spring support.

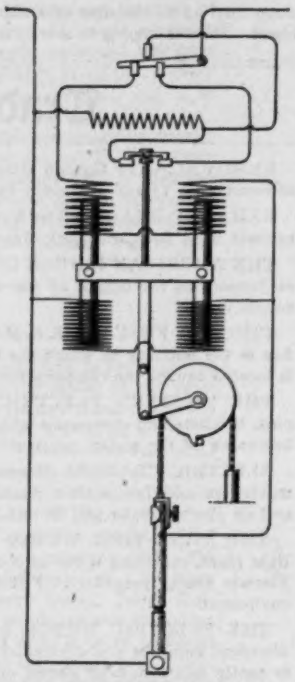


667,374.—Electric Heater for Liquids.

667,519. ELECTRIC METER; J. Harris, Rensselaer, N. Y. App. filed June 2, 1900. A centrifugal governor controls the train of gear.

667,541. MUSICAL CHROMOSCOPE; J. M. Loring, St. Louis, Mo. App. filed May 12, 1900. A series of colored lamps corresponding to the keys of a musical keyboard are lighted up when the keys are played upon.

667,546. TELEPHONIC TRANSMITTER; L. Mellett, Somerville, Mass. App. filed June 14, 1900. A device to maintain the carbon grains in a loose condition.



667,584.—Electric Arc Lamp.

667,567. CONDUIT FOR ELECTRIC WIRES; E. D. Page, New York, N. Y. App. filed May 14, 1900. The conduit is provided with a flexible cover so that it may be bent to insert it into undercut grooves in the walls of the conduit.

667,571. TROLLEY WIRE CROSSING; J. W. Perry, Philadelphia, Pa. App. filed May 10, 1900. Details.

667,584. ELECTRIC ARC LAMP; R. Schefbauer, Jersey City, N. J. App. filed May 1, 1900. An alternating current lamp having an inductive reactance and a switch and connections whereby the lamp can be cut out and the reactance cut in, or the lamp and reactance connected in parallel with each other.

667,585. ELECTRIC ARC LAMP; A. Schweitzer, Pittsburg, Pa. App. filed Oct. 6, 1900. Details.

667,619. CONTROLLER FOR ELECTRIC MOTORS; T. W. Eaton, Chicago, Ill. App. filed Oct. 8, 1900. This is an elevator controller in which the movable contacts are carried by the drum shaft, on which their position is adjustable.

667,625. AUTOMATIC ELECTRIC CIRCUIT BREAKER; B. Hopkinson and E. Talbot, London, Eng. App. filed July 16, 1900. The combination of a circuit-breaker, a line supplied with current both through the circuit-breaker and at some other point and an automatically operating electromagnetic mechanism for replacing the circuit breaker actuated by current drawn from the said line.